TAC: Electrical

This document created by the Florida Department of Business and Professional Regulation -

850-487-1824

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

SW11922

1

Date Submitted	02/06/2025	**Section**	454	**Proponent**	Michael Weinbaum
Chapter	4	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

Summary of Modification

Revert 680.5 of 2023 National Electric Code to 2020 National Electric Code text.

Rationale

The 2023 SPGFCI requirements are onerous. For pumps over 40 HP, the required SPGFCI device is not mass produced, and only one vendor in the United States is making them. We have not seen any evidence that people have been injured by current leakage from pool pumps that operate over 150 leg to ground. Further, these devices generally aren't compatible with VFDs.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
The new code requirement is onerous. This proposal keeps the code requirements the same as they are now.

Impact to building and property owners relative to cost of compliance with code
Costs are reduced.

Impact to industry relative to the cost of compliance with code
Industry is not mass-producing the larger devices that the NEC update requires, so this proposal will alleviate that pain point.

Impact to small business relative to the cost of compliance with code
This does not favor or disfavor small businesses.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Yes, preventing electrical shocks and fires is very important

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
This prevents an onerous update to the code

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

There is no discrimination

Does not degrade the effectiveness of the code

The code under this proposal would be just as effective as the 2023 edition of the Florida Building Code..

454.1.4.1.1

Ground-Fault Circuit Interrupters.

Ground-fault circuit interrupters (GFCIs) shall be self-contained units, circuit-breaker or receptacle types, or other listed types. The provisions of the 2023 National Electrical Code 680.5 shall not apply.

...

454.2.16.1

Ground-Fault Circuit Interrupters.

Ground-fault circuit interrupters (GFCIs) shall be self-contained units, circuit-breaker or receptacle types, or other listed types. The provisions of the 2023 National Electrical Code 680.5 shall not apply.

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

SW11927

2

Date Submitted	02/06/2025	**Section**	454.1.1	**Proponent**	Michael Weinbaum
Chapter	4	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

SW11925

Summary of Modification

define "Interlock"

Rationale

Some code enforcement officials believe that an interlock has to be a dedicated device separate from the chemical controller or pump VFD. However, many chemical controllers and pump VFDs are capable of this function, and they should be considered as meeting the requirement if connected and programmed to do so.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Adds clarity

Impact to building and property owners relative to cost of compliance with code
Reduces cost

Impact to industry relative to the cost of compliance with code
No impact.

Impact to small business relative to the cost of compliance with code
No impact.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Yes, the code currently calls for interlock to prevent hazardous situations

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Yes.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Eliminates a small amount of discrimination.

Does not degrade the effectiveness of the code

Does not degrade.

1st Comment Period History

SW11927-G1

Proponent	Dallas Thiesen	Submitted	4/16/2025 9:31:25 AM	Attachments	No

Comment:

The Florida Swimming Pool Association Supports this modification.

1st Comment Period History

SW11927-G2

Proponent	bob vincent	Submitted	4/16/2025 10:58:44 PM	Attachments	No

Comment:

Many devices have been claimed to be electrical interlocks by CPCs and engineers. This definition proposed her is wide, but is useful. Please show the TAC a number of electrical interlocks that meet these criteria and have been or can be used with VSPs and VFDs to accomplish the goal of stopping power to the chemical feeders when the pump is no longer pumping pool water near for any reason.

1st Comment Period History

SW11927-G3

Proponent	bob vincent	Submitted	4/16/2025 11:02:13 PM	Attachments	No

Comment:

Many devices have been claimed to be electrical interlocks by CPCs. This definition proposed here is wide, but is useful in solving this conundrum. Please show the TAC a number of electrical interlock technical data sheets that meet these criteria and have been, or can be, used with VSPs or VFDs to accomplish the goal of stopping power to the chemical feeders when the pump is no longer pumping pool water due to any reason.

1st Comment Period History

SW11927-G4

Proponent	bob vincent	Submitted	4/16/2025 11:36:43 PM	Attachments	No

Comment:

Lets ask the electrical construction TAC about this electrical system fail-safe system. Chemical overfeeds and poisonous gases result in the system when this system fails to shut off power to the chemical feeders. This is rare in Florida, but devastating when it occurs.

“Interlock” means any electronic switch that connects or disconnects power or an enabling signal to a device based on the state of electronic signals from other devices. An interlock may be a standalone device or part of a programmable logic controller that also performs other functions.

“Interlocked” means connected electronically through an interlock.

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

SW11975

3

Date Submitted	02/11/2025	**Section**	454.1.10.4.2	**Proponent**	Dallas Thiesen
Chapter	4	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

Summary of Modification

Creates an exception in the Florida Building Code for the swimming pool and spa equipotential bonding requirements of NFPA 70 Sec. 680.26(2)(a)-(b).

Rationale

The requirements to use a copper or steel grid for the bonding of swimming pool permitter surfaces is not justified and does not provide improvements in the elimination of voltage gradients compared to existing methods. This proposal seeks to maintain the status quo single wire bonding that has been in place in Florida for 20 years. In that 20 year period there has not been a single documented case of the failure of the single wire bonding method. Additionally, it is estimated that the requirements of 2023 NFPA 70 Sec. 680.26(2)(a)-(b) will add between 2% to 10% to the cost of residential pool construction depending on copper prices and even greater costs increases for remodels having to bring the equipotential bonding up to the 2023 NFPA 70 standard.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

This proposal will prevent unnecessary cost increases to consumers.

Impact to industry relative to the cost of compliance with code

This proposal will prevent unnecessary cost increases to the industry.

Impact to small business relative to the cost of compliance with code

This proposal will prevent unnecessary cost increases to the industry.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This preserves the status quo for equipotential bonding which has no record of failure in the 20 years that it has been in use in Florida.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This prevents unnecessary and costly requirements from being adopted in to the Florida Building Code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This prevents specification of materials an methods. NFPA 70 locks consumers and the industry in to a speicific method of compliance whereas this modification allows for multiple methods of compliance and varied use of materials.

Does not degrade the effectiveness of the code

This preserves the status quo for equipotential bonding which has no record of failure in the 20 years that it has been in use in Florida.

SW11975Text Modification

454.1.10.4.2 Equipotential bonding.

Any of the parts specified in Sections 680.26(B)(1) through (B)(7) of the NFPA 70, National Electrical Code that are repaired, replaced, altered, or installed new at an existing swimming pool shall be connected to the existing bonding system using solid copper conductors, insulated, covered, or bare, not smaller than 8 AWG or with rigid metal conduit of brass or other identified corrosion-resistant metal. Connections to bonded parts shall be made in accordance with Section 250.8 of NFPA 70, National Electrical Code. An 8 AWG or larger solid copper bonding conductor provided to reduce voltage gradients in the pool area shall not be required to be extended or attached to remote panelboards, service equipment, or electrodes. All metallic float-in light rings shall be connected to the equipotential bonding grid. Float-in light rings with no provision for bonding, and other devices which do not provide an electrical connection between a metallic underwater luminaire and the forming shell of a wet niche fixture, including screws or bolts not supplied by the luminaire's manufacturer and listed for use with the specific luminaire, shall not be allowed for use with any underwater luminaire that is required to be grounded. Where none of the bonded parts is in direct connection with the pool water, the pool water shall be in direct contact with an approved corrosion-resistant conductive surface that exposes not less than 9 square inches (5800 mm2) of surface area to the pool water at all times. The conductive surface shall be located where it is not exposed to physical damage or dislodgement during usual pool activities, and it shall be bonded in accordance with Section 680.26(B) of the NFPA 70, National Electrical Code. A bonded concrete pool shell shall be considered to be a conductive surface. The interior metallic surface or surfaces of any forming shell (wet niche) shall not be covered with any material, including plaster, except potting compound covering internal bonding connections in conformance with 680.23(B)(2)(b) of NFPA 70, National Electrical Code, shall be allowed.

In lieu of the requirements of NFPA 70 Sec. 680.26(2)(a)-(b) for conductive paved and unpaved swimming pool perimeter surfaces, swimming pools and spas may be bonded by single copper conductor where the following requirements are met:

(1)At least one minimum 8 AWG bare solid copper conductor shall be provided.

(2) The conductors shall follow the contour of the perimeter surface.

(3) Only listed splicing devices or exothermic welding shall be permitted.

(4) The required conductor shall be 450 mm to 600 mm (18 in. to 24 in.) from the inside walls of the pool.

(5) The required conductor shall be secured within or under the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below the subgrade.

Page: 1

Mod11975_TextOfModification.pdf

F.E. Santos PE
5333 COLLINS AVENUE
MIAMI BEACH, Fl 33140
PE # 19522 (Electrical)
Ph: 786.367.3261.
Office: 305.688.2000.Fax: 305.688.3000.Email:shineco1@bellsouth.net

MIAMI-DADE COUNTY
BUILDING & ZONING DEPARTMENT
11805 SW 26TH Street
Miami,Fl 33175-2474
Attn: Mr. Stuart Bazerman Electrical Division Director

March 13, 2007

Ref: Resistance test for bonding installation in new Swimming Pool
Job Name: Nicolas Tempestini Residence Swimming Pool
Job address: 9821 NW 26th Street Doral,Fl

Dear Mr. Bazerman:

This is to certify that an additional Fall-of-Potential test was performed for a different bonding installation at the above address.

The bonding installation consisted of a #8 solid bare copper grid 12"x 12"and 36"wide installed around the perimeter of the pool.

All metallic components of the pool including the reinforcing rebar in the pool walls were bonded to the bonding installation at 4 places.

Copper Clad ground rods were driven adjacent to the pool area and resistance tests was performed to determine the ground continuity between the ground rods and the bonding installation.

A resistance to ground was measured for the bonding installation the results listed below showed resistance with and without copper grid, less than 25 ohms for both systems.

Tests Date: March 7, 2007 (Single # 8) and March 13, 2007(Copper grid)

Test Instruments: Biddle Series 3 Resistance Tester, Simpson 260

		(Single # 8)	(Copper grid)
Location 1:	Adjacent to north side of pool @ 8 feet	= 5.6 ohms	5.9 ohms
Location 2:	Adjacent to east side of pool @ 6 feet	= 3.4 ohms	5.4 ohms
Location 3:	Adjacent to south side of pool @ 5 feet	= 7.7 ohms	8.6 ohms

Should you have any questions regarding the above, or require additional information, please contact us.

Respectfully,

F.E. Santos, PE

Jason W Rice, P.E.
Consulting Engineer
10289 Penningcroft Lane
Mechanicsville, VA 23116
P 804-514-0743
F 804-368-7287

February 1, 2007

FSPA
Attn: Jennifer Hatfield
1718 main st. Suite 303
Sarasota, FL 34236
P 941-952-9293
F 941-366-7433

Project Location: NEC Bonding Issue

Ms. Hatfield,

I would like to take this opportunity to express my professional opinion about the equipotential bonding question as they pertain to pools. It is my opinion that the proposed language for the 2008 NEC, Section 680.26 is sufficient to reduce the potential for voltage gradients in a pool area. The section in question states that providing adequate bonding for a perimeter surface requires a single, minimum 8 AWG, bare solid copper conductor to follow the contour of the pool. This "contour bonding" shall be connected to the pool steel in at least four (4) uniformly spaced locations (except for non-conductive pool shells). Additionally, this contour bonding shall be 18-24 in. from the inside wall of the pool and secured under 4-6 in. of topsoil. All splicing and connections shall conform to NEC requirements.

I have had the opportunity as engineer of record on more than 3,000 pool related projects, both commercial and residential. Additionally, I have actively been providing electrical engineering designs in the residential, commercial and

industrial industries for the past 12 years. It is my professional opinion that the above perimeter bonding is all that is required to ensure a reduction in the potential for voltage gradients for the perimeter surfaces in a pool area.

Please don't hesitate to contact me if you have any further questions or comments.

Sincerely,

Jason W. Rice, P.E.

Attachments: 1 – Jason Rice Curriculum Vitae

Jason W. Rice, PE

Mr. Rice has over 12 years of professional experience in all aspects of governmental, institutional, commercial, industrial, residential, recreational, structural, electrical and environmental engineering. His work has traversed the United States, the Caribbean and includes the engineering of more than 3,500 projects (over 2,000 pools) and conducting over 1,000 inspections.

His He is supported by three assistants, a field technician, a GIS technician and a project engineer. The field technician is licensed as a Certified Pool Operator and a Pool & Spa Repair Contractor with over 10 years' experience in the pool industry. The GIS technician has over 10 years' of government, commercial and residential engineering experience. The project engineer is a mechanical engineer with over 15 years of design engineering experience.

Prior to his independent consulting work, Mr. Rice worked with an environmental and electrical engineering, design-build firm and several multi-disciplined, civil & MEP engineering firms. His responsibilities were in all phases of engineering, from assisting clients with conceptual layout, preliminary or forensic inspections and review, obtaining public official approval on preliminary designs, preparing the final design documents, management of construction (including inspections) to the final turnover to the client. Mr Rice's experience provides not only multi-discipline engineering design but also a firm comprehension of how these fields affect the overall scope on a project.

Commercial

Electrical, Columbia Restaurant, Sarasota, FL. The engineering design of modifications to the 1000A electrical distribution system.

Electrical, Dwyers Irish Pub, Ft Myers, FL. The engineering design of modifications to the 2000A electrical distribution system.

Electrical, Metro Coffee & Wine Club, Sarasota, FL. The engineering design of modifications to the 2500A electrical distribution system.

Electrical, Sarasota Commercial Management Office Building, Sarasota, FL. The engineering design of modifications to the 1000A electrical distribution system.

Electrical, Mariott Resort, West Palm Beach, FL. The engineering design of the modifications to a 800A electrical distribution system.

Electrical, AutoPilot Systems, Ft Lauderdale, FL. The engineering design of the modifications to the 2000A electrical distribution system.

Electrical, Lo Chlor, Ft Lauderdale, FL. The engineering design of the manufacturing control system.

Electrical, Days Inn, Port Charlotte, FL. The engineering design of the fire alarm and control system.

Electrical, Collier County Public Library, Immokalee, FL. The engineering design of the fire alarm and control system.

Registrations:
Professional
Engineer/FL/2002

Professional
Engineer/VA/2004

Professional
Engineer/MD/2004

Professional Memberships:

American Concrete Institute

Association of Pool & Spa Professionals

National Fire Prevention Association, NEC

Florida Swimming Pool Association

Community Involvement:

King's Charter Architectural Control Committee Member, 2006-2007.

Florida Swimming Pool Association, State of Florida Technical Advisor, responsible for providing technical and building code guidance on policies and represented the association at the state and national level, 2004-2006.

Conducted Building Code Training Courses for city officials, various Broward & Palm Beach County cities, FL 2004 - 2005.

Electrical, Homewood Suites by Hilton, Sarasota, FL. The engineering design of the fire alarm and control system.

Electrical, The Courtyard at Market Square, Sarasota, FL. The engineering design of the fire alarm and control system.

Electrical, Homewood Suites by Hilton, Sarasota, FL. The engineering design of the fire alarm and control system.

Water Resources, The Singer Island Resort, Singer Island, FL. a 1,500+ SF, beach entry and recreational slide swimming pool, a 850+ SF perimeter overflow formal pool and a 35+ SF spa. All of these pools are located above the parking garage and supported on a column system structural design.

Water Resources, Walt Disney World, Typhoon Lagoon, Orlando, FL, a 2000+ SF, 170,000+ gal beach entry and recreational slide swimming pool. The engineering included all hydraulic, electrical, structural and mechanical systems. Provided construction management on all phases.

Water Resources, US Marines, 29 Palms Base, Adobe Flats II Clubhouse, Ocotillo Heights Community Center, Desert View Terrace Clubhouse, Twenty-Nine Palms, CA, three (3) separate 1,200 SF, 45,000 gal pools with kiddie water feature play areas. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, Landstar-Waterstone Development, Miami, FL a 2000+ SF, 120,000+ gal pool, 200+ SF kiddie pool and 35+ SF spa. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, The Mariott Courtard, Pembroke Pines, FL, a 800+ SF, 30,000+ gal pool. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, The Aman Yara Resort, Turks & Caicos Island, a 2000+ SF, 120,000+ gal pool, 200+ SF kiddie pool and 35+ SF spa. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, Rolling Hills Golf & CC, Akron, OH, remodeling of a 1,800 SF pool and decking. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, The Jungle Club, Vero Beach, FL, remodeling of a 2,800 SF pool, a 49 SF spa and a new 2,300 SF pool. The engineering included all hydraulic, electrical, structural and mechanical systems.

Drainage Design, Universal Studios, Universal's Islands of Adventure, Orlando, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system;

International Aquatics Foundation, member of IAF-7 committee, this committee is responsible for updating the national code for swimming pool standards, Washington DC, 2005

Facing It Together, non-profit organization that raises money through sponsorship of athletic events and provides monies for surgical reconstruction of facial abnormalities for disadvantaged children, Broward County, FL 2004 - 2006.

Leukemia & Lymphoma Society, non-profit organization that raises money through sponsorship of athletic events and provides monies for research into the treatment of cancer, Palm Springs, CA 2003 - 2004.

Residential

Electrical, Falcone Residence, Boca Raton, FL. The engineering design of the 1500A electrical distribution system on new residence.

Electrical, Manchester Residence, Sarasota, FL. The engineering design of the refurbishments to the 1600A electrical distribution system on an existing residence.

Electrical, Cannon Residence, Sarasota, FL. The engineering design of the refurbishments to the 600A electrical distribution system on an existing residence.

Water Resources, Brown Residence, Paradise Island, Bahamas, engineering design of 600 SF, 18,000 gal., deep foundation koi pond and multiple water features. Additionally, this project included the design of a 1,800 SF, 180,000 gal. pool, a 28 foot single-span RC bridge, a 120 SF, 4 column, grade beam and deep foundation gazebo structure, a 240 SF by 8 feet high RC and masonry deep foundation water fall structure. The engineering included all hydraulic, electrical, structural and mechanical systems. Provided construction management on all phases.

Water Resources, Venturi Residence, Ft Lauderdale, FL. Engineering design of 1,200 SF, 96,000 gal. pool and a 600 SF, two-story, RC and masonry waterfall/cave structure. A key feature of the cave was the 28 feet single span opening on one side. The engineering included all hydraulic, electrical, structural (shallow foundation) and mechanical systems. Provided construction management on all phases.

Water Resources, Smith Residence, Plantation, FL. Engineering design of 500 SF, 21,000 gal. pool and a 100 SF, two-story, RC spa and waterfall structure. The engineering included all hydraulic, electrical, structural (shallow foundation) and mechanical systems..

Municipal

Control System/Drainage Design, Gore Street Alum Treatment System, City of Orlando, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Lake Howard Alum Treatment System, City of Winter Haven, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Port Orange Alum Treatment System, City of Port Orange, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, East Lake Alum Treatment System, Hillsborough County, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Clearwater Alum Treatment System, City of Clearwater, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Winter Park Alum Treatment System, City of Winter Park, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Polk County Environmental Services, Lake Blue/Lake Cannon, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Water and Sewer, Miami-Dade Water & Sewer, Alexander Orr Water Treatment Plant, Miami, FL. Complete design of temperature and vibration control systems on four, 2000 amp emergency generators. Provided installation, startup and calibration of the complete system.

Control System/Water and Sewer, East Waste Water Treatment Plant, City of Orlando, FL. Provided hydraulic and controls engineering and design of refurbishments to 100,000 GPD reuse system and annual hydraulic system testing, calibration and certification. Provided controls and electrical engineering design for activated sludge, heat-tracing system.

Control System/Water and Sewer, Bradenton Waste Water Treatment Plant, City of Bradenton, FL. Engineering design and build of methanol feed system for 35 MGD plant.

Water and Sewer, Sykes Creek Waste Water Treatment Plant, Brevard County, FL. Engineering design of rehab to 25 MGD influent structure hydraulics, monitoring and control system.

Control System/Water and Sewer, US Air Force, Tyndall AFB Waste Water Treatment Plant, Tyndall, FL. Engineering design and build of effluent hydraulic, UV treatment and control system for 100,000 GPD plant.

industrial industries for the past 12 years. It is my professional opinion that the above perimeter bonding is all that is required to ensure a reduction in the potential for voltage gradients for the perimeter surfaces in a pool area.

Please don't hesitate to contact me if you have any further questions or comments.

Sincerely,

Jason W. Rice, P.E.

Attachments: 1 – Jason Rice Curriculum Vitae

Electro-Kinetic Corporation

Licensed Electrical Contractors

1801 S. Ocean Drive Hallandale, Fl. 33009 Phone/Fax (954) 456-7889

March 8, 2007

Stu Bazerman
11805 SW 26th Street
Miami, Fl. 33175-2474

Job Name: Angie Daza
Job Address: 11103 NW 71 Terrace Doral, Fl.

Dear Mr. Bazerman,

We have inspected and tested the bonding components of the swimming pool installed at the above address. A single #8 bond wire has been installed 360 degrees around the swimming pool. This bonding conductor is 18" from the inside of the pool wall. All metallic components of the pool are bonded to this wire including the reinforcing rods in the pool walls. We certify that the installed components meet the requirements of Article 680 of the National Electric Code. Resistance tests of the bonded equipment were completed on March 7, 2007.

Copper Clad ground rods were driven adjacent to the pool area and resistance tests performed to determine the ground continuity between the ground rods and the bonded pool equipment. An acceptable resistance to ground was measured for this swimming pool bonding system (less than 25 ohms). There is no further recommendation for additional bonding methods required for this location. The results of our resistance tests of the bonded equipment are listed below.

Test Date: March 7, 2007
Test Instruments: Biddle Series 3 Resistance Tester; Simpson 260

Location 1:	Adjacent to west side of pool @ 6 feet	16.8 ohms
Location 2:	Adjacent to north side of spa @ 5 feet	12.1 ohms
Location 3:	Adjacent to south side of pool @ 6 feet	13.4 ohms

Sincerely,

George DeSalle
Florida State Certification: # EC 1767

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

SW11978

4

Date Submitted	02/11/2025	**Section**	454.1.8.15	**Proponent**	Dallas Thiesen
Chapter	4	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments Yes

Alternate Language No

Related Modifications

Summary of Modification

Excepts spas equipped with gravity flow drain systems from the emergency cut off switch requirements of NFPA 70.

Rationale

Spas with gravity flow drain systems are at extremely low risk for suction entrapment incidents. The inclusion of an unnecessary cutoff switch can lead to unsanitary spa conditions when the switch is accidentally or intentionally erroneously activated. The Florida Department of Health argued for the adoption of gravity flow systems due to their inherent safety.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

Reduces costs by preventing nuisance trips.

Impact to industry relative to the cost of compliance with code

Reduces costs by preventing nuisance trips.

Impact to small business relative to the cost of compliance with code

Reduces costs by preventing nuisance trips.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Spas with gravity flow drain systems are at extremely low risk for suction entrapment incidents. The inclusion of an unnecessary cutoff switch can lead to unsanitary spa conditions when the switch is accidentally or intentionally erroneously activated.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Spas with gravity flow drain systems are at extremely low risk for suction entrapment incidents. The inclusion of an unnecessary cutoff switch can lead to unsanitary spa conditions when the switch is accidentally or intentionally erroneously activated.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposal does not specify a product or material.

Does not degrade the effectiveness of the code

Spas with gravity flow drain systems are at extremely low risk for suction entrapment incidents. The inclusion of an unnecessary cutoff switch can lead to unsanitary spa conditions when the switch is accidentally or intentionally erroneously activated.

1st Comment Period History

SW11978-G1

Proponent	Michael Weinbaum	Submitted	4/9/2025 9:10:20 PM	Attachments	No

Comment:

Martin Aquatic supports this code change. We note that emergency stops would still be required on some public spas in Florida that were built without gravity drainage, before Florida required gravity drainage on all public pools. We think it is appropriate to maintain the requirement for these spas only, and let the vast majority of spas not have them, because the vast majority have inherent protection against suction entrapment already.

454.1.8.15 Emergency cutoff switches

Spas equipped with gravity flow drain systems, regardless of when constructed, are exempted from Section 680.41 of NFPA-70.

However, ~~I~~if a spa is equipped with an emergency cutoff or kill switch, it shall include provisions for a minimum 80 decibel audible alarm near the spa to sound continuously until deactivated when such device is triggered. The following additional rule sign shall be installed to be visible by the spa which reads “ALARM INDICATES SPA PUMPS OFF. DO NOT USE SPA WHEN ALARM SOUNDS UNTIL ADVISED OTHERWISE.”

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

SW12005

5

Date Submitted	02/11/2025	**Section**	454.2.16	**Proponent**	Dallas Thiesen
Chapter	4	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

Summary of Modification

Creates and exception to the 2023 NFPA 70 for bonding pools and spas. Preserves the status quo for equipotential bonding which has no record of failure in the 20 years that it has been in use in Florida.

Rationale

The requirements to use a copper or steel grid for the bonding of swimming pool permitter surfaces is not justified and does not provide improvements in the elimination of voltage gradients compared to existing methods. This proposal seeks to maintain the status quo single wire bonding that has been in place in Florida for 20 years. In that 20 year period there has not been a single documented case of the failure of the single wire bonding method. Additionally, it is estimated that the requirements of 2023 NFPA 70 Sec. 680.26(2)(a)-(b) will add between 2% to 10% to the cost of residential pool construction depending on copper prices and even greater costs increases for remodels having to bring the equipotential bonding up to the 2023 NFPA 70 standard.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Simplifies enforcement by eliminating potential confusion.

Impact to building and property owners relative to cost of compliance with code
This proposal will prevent unnecessary cost increases to consumers.

Impact to industry relative to the cost of compliance with code
This proposal will prevent unnecessary cost increases to the industry.

Impact to small business relative to the cost of compliance with code
This proposal will prevent unnecessary cost increases to the industry.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This preserves the status quo for equipotential bonding which has no record of failure in the 20 years that it has been in use in Florida.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This preserves the status quo for equipotential bonding which has no record of failure in the 20 years that it has been in use in Florida.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This prevents specification of materials an methods. NFPA 70 locks consumers and the industry in to a specific method of compliance whereas this modification allows for multiple methods of compliance and varied use of materials.

Does not degrade the effectiveness of the code

This preserves the status quo for equipotential bonding which has no record of failure in the 20 years that it has been in use in Florida.

SW12005Text Modification

454.2.16 Electrical.

Electrical equipment wiring and installation, including the bonding and grounding of pool components, shall comply with Chapter 27 of the Florida Building Code, Building. Outlets supplying pool pump motors connected to single-phase 120-volt through 240-volt branch circuits, whether by receptacle or by direct connection, and outlets supplying other electrical equipment and underwater luminaires operating at voltages greater than the low voltage contact limit, connected to single-phase, 120 volt through 240 volt branch circuits, rated 15 or 20 amperes, whether by receptacle or by direct connection, shall be provided with ground-fault circuit interrupter protection for personnel.

Exception: In lieu of the requirements of NFPA 70 Sec. 680.26(2)(a)-(b) for conductive paved and unpaved swimming pool perimeter surfaces, swimming pools and spas may be bonded by single copper conductor where the following requirements are met:

(1) At least one minimum 8 AWG bare solid copper conductor shall be provided.

(2) The conductors shall follow the contour of the perimeter surface.

(3) Only listed splicing devices or exothermic welding shall be permitted.

(4) The required conductor shall be 450 mm to 600 mm (18 in. to 24 in.) from the inside walls of the pool.

(5) The required conductor shall be secured within or under the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below the subgrade.

Page: 1

Mod12005_TextOfModification.pdf

F.E. Santos PE
5333 COLLINS AVENUE
MIAMI BEACH, Fl 33140
PE # 19522 (Electrical)
Ph: 786.367.3261.
Office: 305.688.2000.Fax: 305.688.3000.Email:shineco1@bellsouth.net

MIAMI-DADE COUNTY
BUILDING & ZONING DEPARTMENT
11805 SW 26TH Street
Miami,Fl 33175-2474
Attn: Mr. Stuart Bazerman Electrical Division Director

March 13, 2007

Ref: Resistance test for bonding installation in new Swimming Pool
Job Name: Nicolas Tempestini Residence Swimming Pool
Job address: 9821 NW 26th Street Doral,Fl

Dear Mr. Bazerman:

This is to certify that an additional Fall-of-Potential test was performed for a different bonding installation at the above address.

The bonding installation consisted of a #8 solid bare copper grid 12"x 12"and 36"wide installed around the perimeter of the pool.

All metallic components of the pool including the reinforcing rebar in the pool walls were bonded to the bonding installation at 4 places.

Copper Clad ground rods were driven adjacent to the pool area and resistance tests was performed to determine the ground continuity between the ground rods and the bonding installation.

A resistance to ground was measured for the bonding installation the results listed below showed resistance with and without copper grid, less than 25 ohms for both systems.

Tests Date: March 7, 2007 (Single # 8) and March 13, 2007(Copper grid)

Test Instruments: Biddle Series 3 Resistance Tester, Simpson 260

		(Single # 8)	(Copper grid)
Location 1:	Adjacent to north side of pool @ 8 feet	= 5.6 ohms	5.9 ohms
Location 2:	Adjacent to east side of pool @ 6 feet	= 3.4 ohms	5.4 ohms
Location 3:	Adjacent to south side of pool @ 5 feet	= 7.7 ohms	8.6 ohms

Should you have any questions regarding the above, or require additional information, please contact us.

Respectfully,

F.E. Santos, PE

Jason W Rice, P.E.
Consulting Engineer
10289 Penningcroft Lane
Mechanicsville, VA 23116
P 804-514-0743
F 804-368-7287

February 1, 2007

FSPA
Attn: Jennifer Hatfield
1718 main st. Suite 303
Sarasota, FL 34236
P 941-952-9293
F 941-366-7433

Project Location: NEC Bonding Issue

Ms. Hatfield,

I would like to take this opportunity to express my professional opinion about the equipotential bonding question as they pertain to pools. It is my opinion that the proposed language for the 2008 NEC, Section 680.26 is sufficient to reduce the potential for voltage gradients in a pool area. The section in question states that providing adequate bonding for a perimeter surface requires a single, minimum 8 AWG, bare solid copper conductor to follow the contour of the pool. This "contour bonding" shall be connected to the pool steel in at least four (4) uniformly spaced locations (except for non-conductive pool shells). Additionally, this contour bonding shall be 18-24 in. from the inside wall of the pool and secured under 4-6 in. of topsoil. All splicing and connections shall conform to NEC requirements.

I have had the opportunity as engineer of record on more than 3,000 pool related projects, both commercial and residential. Additionally, I have actively been providing electrical engineering designs in the residential, commercial and

industrial industries for the past 12 years. It is my professional opinion that the above perimeter bonding is all that is required to ensure a reduction in the potential for voltage gradients for the perimeter surfaces in a pool area.

Please don't hesitate to contact me if you have any further questions or comments.

Sincerely,

Jason W. Rice, P.E.

Attachments: 1 – Jason Rice Curriculum Vitae

Jason W. Rice, PE

Mr. Rice has over 12 years of professional experience in all aspects of governmental, institutional, commercial, industrial, residential, recreational, structural, electrical and environmental engineering. His work has traversed the United States, the Caribbean and includes the engineering of more than 3,500 projects (over 2,000 pools) and conducting over 1,000 inspections.

His He is supported by three assistants, a field technician, a GIS technician and a project engineer. The field technician is licensed as a Certified Pool Operator and a Pool & Spa Repair Contractor with over 10 years' experience in the pool industry. The GIS technician has over 10 years' of government, commercial and residential engineering experience. The project engineer is a mechanical engineer with over 15 years of design engineering experience.

Prior to his independent consulting work, Mr. Rice worked with an environmental and electrical engineering, design-build firm and several multi-disciplined, civil & MEP engineering firms. His responsibilities were in all phases of engineering, from assisting clients with conceptual layout, preliminary or forensic inspections and review, obtaining public official approval on preliminary designs, preparing the final design documents, management of construction (including inspections) to the final turnover to the client. Mr Rice's experience provides not only multi-discipline engineering design but also a firm comprehension of how these fields affect the overall scope on a project.

Commercial

Electrical, Columbia Restaurant, Sarasota, FL. The engineering design of modifications to the 1000A electrical distribution system.

Electrical, Dwyers Irish Pub, Ft Myers, FL. The engineering design of modifications to the 2000A electrical distribution system.

Electrical, Metro Coffee & Wine Club, Sarasota, FL. The engineering design of modifications to the 2500A electrical distribution system.

Electrical, Sarasota Commercial Management Office Building, Sarasota, FL. The engineering design of modifications to the 1000A electrical distribution system.

Electrical, Mariott Resort, West Palm Beach, FL. The engineering design of the modifications to a 800A electrical distribution system.

Electrical, AutoPilot Systems, Ft Lauderdale, FL. The engineering design of the modifications to the 2000A electrical distribution system.

Electrical, Lo Chlor, Ft Lauderdale, FL. The engineering design of the manufacturing control system.

Electrical, Days Inn, Port Charlotte, FL. The engineering design of the fire alarm and control system.

Electrical, Collier County Public Library, Immokalee, FL. The engineering design of the fire alarm and control system.

Registrations: Professional
Engineer/FL/2002

Professional Engineer/VA/2004

Professional Engineer/MD/2004

Professional Memberships:
American Concrete Institute

Association of Pool & Spa Professionals

National Fire Prevention Association, NEC

Florida Swimming Pool Association

Community Involvement:
King's Charter Architectural Control Committee Member, 2006-2007.

Florida Swimming Pool Association, State of Florida Technical Advisor, responsible for providing technical and building code guidance on policies and represented the association at the state and national level, 2004-2006.

Conducted Building Code Training Courses for city officials, various Broward & Palm Beach County cities, FL 2004 - 2005.

Electrical, Homewood Suites by Hilton, Sarasota, FL. The engineering design of the fire alarm and control system.

Electrical, The Courtyard at Market Square, Sarasota, FL. The engineering design of the fire alarm and control system.

Electrical, Homewood Suites by Hilton, Sarasota, FL. The engineering design of the fire alarm and control system.

Water Resources, The Singer Island Resort, Singer Island, FL. a 1,500+ SF, beach entry and recreational slide swimming pool, a 850+ SF perimeter overflow formal pool and a 35+ SF spa. All of these pools are located above the parking garage and supported on a column system structural design.

Water Resources, Walt Disney World, Typhoon Lagoon, Orlando, FL, a 2000+ SF, 170,000+ gal beach entry and recreational slide swimming pool. The engineering included all hydraulic, electrical, structural and mechanical systems. Provided construction management on all phases.

Water Resources, US Marines, 29 Palms Base, Adobe Flats II Clubhouse, Ocotillo Heights Community Center, Desert View Terrace Clubhouse, Twenty-Nine Palms, CA, three (3) separate 1,200 SF, 45,000 gal pools with kiddie water feature play areas. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, Landstar-Waterstone Development, Miami, FL a 2000+ SF, 120,000+ gal pool, 200+ SF kiddie pool and 35+ SF spa. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, The Mariott Courtard, Pembroke Pines, FL, a 800+ SF, 30,000+ gal pool. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, The Aman Yara Resort, Turks & Caicos Island, a 2000+ SF, 120,000+ gal pool, 200+ SF kiddie pool and 35+ SF spa. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, Rolling Hills Golf & CC, Akron, OH, remodeling of a 1,800 SF pool and decking. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, The Jungle Club, Vero Beach, FL, remodeling of a 2,800 SF pool, a 49 SF spa and a new 2,300 SF pool. The engineering included all hydraulic, electrical, structural and mechanical systems.

Drainage Design, Universal Studios, Universal's Islands of Adventure, Orlando, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system;

International Aquatics Foundation, member of IAF-7 committee, this committee is responsible for updating the national code for swimming pool standards, Washington DC, 2005

Facing It Together, non-profit organization that raises money through sponsorship of athletic events and provides monies for surgical reconstruction of facial abnormalities for disadvantaged children, Broward County, FL 2004 - 2006.

Leukemia & Lymphoma Society, non-profit organization that raises money through sponsorship of athletic events and provides monies for research into the treatment of cancer, Palm Springs, CA 2003 - 2004.

Residential

Electrical, Falcone Residence, Boca Raton, FL. The engineering design of the 1500A electrical distribution system on new residence.

Electrical, Manchester Residence, Sarasota, FL. The engineering design of the refurbishments to the 1600A electrical distribution system on an existing residence.

Electrical, Cannon Residence, Sarasota, FL. The engineering design of the refurbishments to the 600A electrical distribution system on an existing residence.

Water Resources, Brown Residence, Paradise Island, Bahamas, engineering design of 600 SF, 18,000 gal., deep foundation koi pond and multiple water features. Additionally, this project included the design of a 1,800 SF, 180,000 gal. pool, a 28 foot single-span RC bridge, a 120 SF, 4 column, grade beam and deep foundation gazebo structure, a 240 SF by 8 feet high RC and masonry deep foundation water fall structure. The engineering included all hydraulic, electrical, structural and mechanical systems. Provided construction management on all phases.

Water Resources, Venturi Residence, Ft Lauderdale, FL. Engineering design of 1,200 SF, 96,000 gal. pool and a 600 SF, two-story, RC and masonry waterfall/cave structure. A key feature of the cave was the 28 feet single span opening on one side. The engineering included all hydraulic, electrical, structural (shallow foundation) and mechanical systems. Provided construction management on all phases.

Water Resources, Smith Residence, Plantation, FL. Engineering design of 500 SF, 21,000 gal. pool and a 100 SF, two-story, RC spa and waterfall structure. The engineering included all hydraulic, electrical, structural (shallow foundation) and mechanical systems..

Municipal

Control System/Drainage Design, Gore Street Alum Treatment System, City of Orlando, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Lake Howard Alum Treatment System, City of Winter Haven, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Port Orange Alum Treatment System, City of Port Orange, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, East Lake Alum Treatment System, Hillsborough County, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Clearwater Alum Treatment System, City of Clearwater, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Winter Park Alum Treatment System, City of Winter Park, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Polk County Environmental Services, Lake Blue/Lake Cannon, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Water and Sewer, Miami-Dade Water & Sewer, Alexander Orr Water Treatment Plant, Miami, FL. Complete design of temperature and vibration control systems on four, 2000 amp emergency generators. Provided installation, startup and calibration of the complete system.

Control System/Water and Sewer, East Waste Water Treatment Plant, City of Orlando, FL. Provided hydraulic and controls engineering and design of refurbishments to 100,000 GPD reuse system and annual hydraulic system testing, calibration and certification. Provided controls and electrical engineering design for activated sludge, heat-tracing system.

Control System/Water and Sewer, Bradenton Waste Water Treatment Plant, City of Bradenton, FL. Engineering design and build of methanol feed system for 35 MGD plant.

Water and Sewer, Sykes Creek Waste Water Treatment Plant, Brevard County, FL. Engineering design of rehab to 25 MGD influent structure hydraulics, monitoring and control system.

Control System/Water and Sewer, US Air Force, Tyndall AFB Waste Water Treatment Plant, Tyndall, FL. Engineering design and build of effluent hydraulic, UV treatment and control system for 100,000 GPD plant.

industrial industries for the past 12 years. It is my professional opinion that the above perimeter bonding is all that is required to ensure a reduction in the potential for voltage gradients for the perimeter surfaces in a pool area.

Please don't hesitate to contact me if you have any further questions or comments.

Sincerely,

Jason W. Rice, P.E.

Attachments: 1 – Jason Rice Curriculum Vitae

SW12005Rationale

Electro-Kinetic Corporation

Licensed Electrical Contractors

1801 S. Ocean Drive Hallandale, Fl. 33009 Phone/Fax (954) 456-7889

March 8, 2007

Stu Bazerman
11805 SW 26th Street
Miami, Fl. 33175-2474

Job Name: Angie Daza
Job Address: 11103 NW 71 Terrace Doral, Fl.

Dear Mr. Bazerman,

We have inspected and tested the bonding components of the swimming pool installed at the above address. A single #8 bond wire has been installed 360 degrees around the swimming pool. This bonding conductor is 18" from the inside of the pool wall. All metallic components of the pool are bonded to this wire including the reinforcing rods in the pool walls. We certify that the installed components meet the requirements of Article 680 of the National Electric Code. Resistance tests of the bonded equipment were completed on March 7, 2007.

Copper Clad ground rods were driven adjacent to the pool area and resistance tests performed to determine the ground continuity between the ground rods and the bonded pool equipment. An acceptable resistance to ground was measured for this swimming pool bonding system (less than 25 ohms). There is no further recommendation for additional bonding methods required for this location. The results of our resistance tests of the bonded equipment are listed below.

Test Date: March 7, 2007
Test Instruments: Biddle Series 3 Resistance Tester; Simpson 260

Location 1:	Adjacent to west side of pool @ 6 feet	16.8 ohms
Location 2:	Adjacent to north side of spa @ 5 feet	12.1 ohms
Location 3:	Adjacent to south side of pool @ 6 feet	13.4 ohms

Sincerely,

George DeSalle
Florida State Certification: # EC 1767

Page: 1

Mod_12005_Rationale_DeSalle Bonding Tests_2007.pdf

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

SW12111

6

Date Submitted	02/14/2025	**Section**	454.1.10.4.1	**Proponent**	John Hall
Chapter	4	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Summary of Modification

This modification is a local technical amendment to address the voltage limitations for commercial swimming pools.

Rationale

This is a local technical amendment to limit the voltage of underwater lighting in commercial swimming pools. This amendment will limit the voltage levels in underwater swimming pools which will provide a greater degree of safety to pool users.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

The impact to the local entity (Miami-Dade County) will zero due to the fact that this provision has been in the county code for several years. This amendment is an update of language in 454.1.4.2.5.

Impact to building and property owners relative to cost of compliance with code

The impact to building and property owners will not change due to the fact that this is simply an update to current language already adopted locally.

Impact to industry relative to the cost of compliance with code

The impact to industry will be none, due to the fact that this provision has been in effect for several years. This is an update to the previous language.

Impact to small business relative to the cost of compliance with code

Impact to small business relative the cost of compliance will be zero due to the fact that this provision has been in effect for several years. This is simply an update to the language.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This provision has a direct connection with the health, safety, and welfare of the general public by reducing the voltage level in swimming pools should an event occur regarding a malfunction in the pool lighting equipment..

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This provision strengthens the code by providing better products, methods and systems of providing the required illumination on swimming pools.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This provision limits the hazard from line voltage shock incidents in swimming pools.

Does not degrade the effectiveness of the code

This provision does not degrade the effectiveness of the code. To the contrary, this provision increases the effectiveness of the code by reducing the shock hazard in swimming pools.

1st Comment Period History

SW12111-G1

Proponent	bob vincent	Submitted	4/16/2025 11:53:54 PM	Attachments	No

Comment:

Department of Health supports this revision.

SW12111Text Modification

454.1.10.4.1 Ground-fault circuit interrupter protection for personnel.

Outlets supplying repaired, replaced, altered, or relocated poolpump motors connected to single-phase, 120-voltthrough 240-voltbranch circuits, whether by receptacle or by direct connection, and outlets supplying all other repaired, replaced, altered, or relocated electrical equipment ~~and underwater luminaires operating at voltages greater than the low voltage contact limit,~~ connected to single-phase,~~,~~ 120-volt through240-volt branch circuits, rated 15- and 20-amperes, whether by receptacle or by direct connection, shall be provided with ground-fault circuit interrupter protection for personnel. For underwater luminaires refer to **454.1.4.2.5 Voltage limitation.**

Page: 1

Mod12111_TextOfModification.pdf

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

SW12115

7

Date Submitted	02/14/2025	**Section**	454.2.16	**Proponent**	John Hall
Chapter	4	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

Summary of Modification

This modification is a local technical amendment to adderss the voltage limitations for residential swimming pools.

Rationale

This is a local technical amendment to limit the voltage of underwater lighting in private swimming pools. This amendment will limit the voltage levels in underwater swimming pools which will provide a greater degree of safety to pool users.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

The impact to the local entity (Miami-Dade County) will be zero due to the fact that this provision has been in the county code for several years. This amendment is an update of language in 454.

Impact to building and property owners relative to cost of compliance with code

The impact to building and property owners will not change due to the fact that this is simply an update to current language already adopted locally.

Impact to industry relative to the cost of compliance with code

The impact to industry will be none, due to the fact that this provision has been in effect for several years. This is an update to the previous language.

Impact to small business relative to the cost of compliance with code

The impact to small business related to the cost of compliance will remain as is due to the fact that this provision has been in effect for several years.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This provision has a direct connection with the health, safety, and welfare of the general public by reducing the voltage level in swimming pools should an event occur regarding a malfunction in the pool lighting equipment..

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This provision strengthens the code by providing better products, methods and systems of providing the required illumination on swimming pools.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This provision limits the hazard from line voltage shock incidents in swimming pools.

Does not degrade the effectiveness of the code

This provision does not degrade the effectiveness of the code. To the contrary, this provision increases the effectiveness of the code by reducing the shock hazard in swimming pools.

SW12115Text Modification

454.2.16

Electric equipment wiring and installation, including the bonding and grounding of pool components, shall comply with Chapter 27 of the *Florida Building Code, Building.* Outlets supplying pool pump motors connected to single-phase 120-volt through 240-volt branch circuits, whether by receptacle or by direct connection, and outlets supplying all other repaired, replaced, altered, or relocated electrical equipment ~~and undewater luminaires operating at voltages greater than the low voltage contact limit,~~ connected to single-phase, 120 volt through 240 volt branch circuits, rated 15 or 20 amperes, whether by receptacle or by direct connection, shall be provided with ground-fault circuit interrupter protection for personnel.

454.2.16.1 Voltage Limitation. Underwater lighting, or lighting that may be exposed to nozzle-directed pool water, shall not exceed 30 volts DC or 15 volts AC. Such lights shall be installed in accordance with manufacturer's installation instructions and be listed by a nationally recognized testing laboratory.

Mod12115_TextOfModification.pdf Page: 1

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

R12141

8

Date Submitted	02/14/2025	**Section**	1510.8.6	**Proponent**	Amanda Hickman
Chapter	15	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

no

Summary of Modification

Updates Rooftop Structures for LPS

Rationale

Lightning Protection systems (LPS) are required to be installed on roofs of hospitals and nursing facilities per the FL code. However, no guidance exists in the code on how to appropriately attach LPS to the roof so that damage does not occur to the roof. This proposal was added to the 2024 IBC to address this concern even though LPS is not required anywhere per the IBC. Therefore, it is imperative that it be added to the FBC to ensure LPS WHEN installed it is done so in protection of the roof and roof components.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Provides guidance on appropriate installation of LPS to safeguard the roof.
Impact to building and property owners relative to cost of compliance with code
None. Provides guidance on appropriate installation of LPS to safeguard the roof.
Impact to industry relative to the cost of compliance with code
None. Provides guidance on appropriate installation of LPS to safeguard the roof.
Impact to small business relative to the cost of compliance with code
None. Provides guidance on appropriate installation of LPS to safeguard the roof.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Provides guidance on appropriate installation of LPS to safeguard the roof.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No. Provides industry standard practices for installation.

Does not degrade the effectiveness of the code

Provides guidance on appropriate installation of LPS to safeguard the roof.

1st Comment Period History

R12141-G1

Proponent	Dillon Mike	Submitted	4/10/2025 11:47:08 AM	Attachments	No

Comment:

My name is Michael Dillon, and I am with Bonded Lightning Protection. I represent the Lightning Protection Industry, as an installer in Florida. I support this because it aligns FLorida roofing construction with the national model code (IBC) and ensures LPS installations do not negatively impact roofing systems. This will help reduce LPS installer liability for damaged/leaking roofing systems and help standardize LPS practices associated with roofing systems.

1st Comment Period History

R12141-G2

Proponent	Tyler Baumert	Submitted	4/14/2025 2:55:40 PM	Attachments	No

Comment:

My name is Tyler Baumert, and I represent the Lightning Protection Coalition. I am writing to express strong support for Proposal R12141. Proposal R12141 ensures that lightning protection systems are installed without compromising roof performance or warranties. It requires the use of compatible components and compliance with guidance from manufacturers or design professionals. This proposal promotes safety, quality, and accountability—without adding cost burdens to building owners or contractors—and aligns Florida’s code with national best practices already reflected in the 2024 IBC.

1st Comment Period History

R12141-G3

Proponent	Bret Peifer	Submitted	4/14/2025 3:49:17 PM	Attachments	No

Comment:

As a licensed lightning protection contractor, Bret Peifer of Mr. Lightning, I fully support the proposed addition of Section 1510.8.6 to the Florida Building Code, which provides clear guidance on the installation of lightning protection systems on metal edge systems, gutters, and roof coverings. Florida experiences some of the highest rates of lightning activity in the nation, making comprehensive protection measures essential for preserving both property and public safety. This proposal enhances clarity and ensures that lightning protection system components are installed in a manner consistent with tested and approved methods. Requiring compatibility with ANSI/SPRI/FM standards and adherence to manufacturer guidelines or design professional oversight will help prevent damage to roofing systems and maintain the integrity of waterproofing details. By outlining responsibilities when manufacturer instructions are unavailable, this change also helps ensure safe, consistent installations across the state. These provisions represent a thoughtful balance between safety, performance, and practicality, and I commend the initiative to strengthen Florida’s resilience to lightning-related hazards.

1st Comment Period History

R12141-G4

Proponent	harger Tim	Submitted	4/15/2025 4:35:23 PM	Attachments	No

Comment:

My name is Tim Harger from the Lightning Protection Institute, and I support Proposal R12141. This update ensures that lightning protection systems are installed without compromising the performance or warranty of roofing systems. By requiring the use of compatible components and adherence to manufacturer or design professional guidance, this proposal promotes quality, safety, and accountability—without adding costs to building owners or contractors. It helps protect structures, reduce liability, and align Florida's code with national best practices already adopted in the 2024 IBC.

1st Comment Period History

R12141-G5

Proponent	George Po	Submitted	4/16/2025 4:05:05 PM	Attachments	Yes

Comment:

Support of R122141

R12141Text Modification

1510.8.6 Lightning protection systems. Where provided,Lightning protection systems shall be installed in accordance with Sections 1510.8.6.1 and 1510.8.6.2.

1510.8.6.1 Installation on metal edge systems or gutters.
Lightning protection system components attached to a ANSI/SPRI/ FM 4435/ES-1 or ANSI/SPRI GT-1 tested metal edge systems for gutters shall be installed with compatible brackets, fasteners or adhesives, in accordance with the metal edge systems or gutter manufacturer's installation instructions. Where the metal edge system or gutter manufacturer is unknown, installation shall be directed by a *registered design professional*.

1510.8.6.2 Installation on roof coverings.
Lightning protection system components directly attached to or through the *roof covering* shall be installed in accordance with this chapter and the *roof covering* manufacturer's installation instructions. Flashing shall be installed in accordance with the *roof assembly* manufacturer's installation instructions and section 1503.2 and 1507 where the lightning protection system installation results in a penetration through the *roof covering*. Where the *roof covering* manufacturer is unknown, installation shall be directed by a *registered design professional*.

R12141-G5General Comment

George Portfleet here, a member of the United Lightning Protection Association. I support Proposal R12141. This update ensures that lightning protection systems are installed without compromising the performance or warranty of roofing systems. This Proposal requiring the use of compatible components and adherence to manufacturer or design professional guidance, while also promoting quality, safety, and accountability without adding costs to building owners or contractors. It helps protect structures, reduce liability, and aligns Florida's code with national best practices already adopted in the 2024 IBC.

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

S12298

9

Date Submitted	02/18/2025	**Section**	1604.5.3	**Proponent**	Douglas Armstrong
Chapter	16	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Summary of Modification

This specialized code language will provide a systematic, accurate, and consistent approach to evaluating lightning risk for these essential uses and recommend protective measures.

Rationale

There is a lack of a standardized, detailed methodology within the IBC to assess and mitigate lightning risks specifically for Risk Category IV buildings and other structures. These buildings contain essential facilities (e.g., hospitals, emergency shelters) and also those buildings where the loss of function is a real hazard to the occupants/users. The assignment in Risk Category IV is to help ensure these buildings maintain functionality and safety during natural hazards; in this case severe weather events. This specialized code language will provide a systematic, accurate, and consistent approach to evaluating lightning risk for these essential uses and recommend protective measures. Lightning strikes can significantly disrupt hospital operations, affecting both infrastructure and patient care. Key impacts include: Electrical and Electronic System Failures: a. Power Supply Disruptions: Lightning can cause power outages, compromising critical systems. b. Equipment Damage: Sensitive medical devices are vulnerable to voltage spikes from lightning, potentially leading to malfunctions or complete failure. This can impede patient monitoring and treatment. Communication System Interruptions: a. Lightning-induced surges can disrupt hospital communication networks, including telephones, intercoms, and internet services, hindering coordination among medical staff and with external emergency services. Structural Damage: a. Direct lightning strikes can cause fires or physical damage to hospital buildings, posing safety risks to patients and staff and potentially leading to evacuations. To safeguard against these risks, hospitals can implement comprehensive lightning protection systems. Implementing these measures can enhance hospital resilience against lightning-related incidents, ensuring continuity of critical healthcare services. Please see uploaded Support File for more information.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

The Cost per Square Foot of such systems for Low-Rise Buildings is approximately $2.10 to $2.70 per square foot of roof area and Five-Story Buildings is approximately $1.50 to $1.90 per square foot of roof area for the installation of such protective systems based on industry studies.

Impact to industry relative to the cost of compliance with code

The cost impacts are based on industry studies. It is a simple cost of system over roof area provided. The new language should help streamline assessments to integrate seamlessly into design and approval phases, avoiding delays in the construction timeline.

Impact to small business relative to the cost of compliance with code

None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The code modification will help to ensure the continued functionality of essential uses and others designated as Risk Category IV. This includes hospitals, fire stations, police stations, etc.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This specialized code language will provide a systematic, accurate, and consistent approach to evaluating lightning risk for these essential uses and recommend protective measures.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This code modification does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

This improves the effectiveness of the code by clarifying the lightning risk analysis of Category IV buildings

1st Comment Period History

S12298-G1

Proponent	Dillon Mike	Submitted	4/10/2025 11:39:20 AM	Attachments	No

Comment:

My name is Michael Dillon, with Bonded Lightning Protection Systems. I represent the Lightning protection industry as an installer in Florida. I support this proposal because it gives the project developer, building owner, contractors, and building officials industry recognized methods for performing a lightning risk assessment. It also recognizes that risk category IV buildings and structures are especially vulnerable to the hazards of lightning.

1st Comment Period History

S12298-G2

Proponent	Tyler Baumert	Submitted	4/14/2025 2:47:48 PM	Attachments	No

Comment:

My name is Tyler Baumert, and I represent the Lightning Protection Coalition. I am writing to express strong support for Proposals S12298.Proposal S12298 promotes resilience in Risk Category IV buildings—those crucial to public safety during emergencies—by requiring lightning risk assessments based on recognized national and international standards. This ensures objective, data-driven decisions while avoiding unnecessary system mandates. It’s a smart, balanced approach that enhances life safety, supports business continuity, and bolsters community resilience during Florida’s frequent storm events.

1st Comment Period History

S12298-G3

Proponent	harger Tim	Submitted	4/15/2025 4:24:34 PM	Attachments	No

Comment:
My name is Tim Harger from the Lightning Protection Institute. I support S12298, which promotes safer, more resilient Risk Category IV buildings—facilities critical to public safety during emergencies. By requiring a lightning risk assessment based on recognized national and international standards, this proposal ensures informed, objective decisions without mandating unnecessary systems. It enhances life safety, supports business continuity, and strengthens community resilience during Florida's frequent storm events.

1st Comment Period History

S12298-G4

Proponent	George Po	Submitted	4/16/2025 3:59:33 PM	Attachments	Yes

Comment:

Support of S12298

1st Comment Period History

S12298-G5

Proponent	George Po	Submitted	4/16/2025 4:06:42 PM	Attachments	Yes

Comment:

Support of S12298

Add a new Section 1604.5.3 as follows:

1604.5.3 Lightning protection assessment. Those buildings or structures assigned to Risk Category IV shall have a lightning risk assessment in accordance with NFPA 780 or IEC 62305-2.

Chapter 35

Add the following standard:

IEC

IEC 62305-2 2024-9 Protection against lightning, Part 2: Risk Management 2703.1.1

International Electrotechnical Commission

3, rue de Varembe

CH-1211 Geneva 20

Switzerland

S12298Text Modification

IEC 62305-2

Edition 3.0 2024-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Protection against lightning –
Part 2: Risk management

Protection contre la foudre –
Partie 2: Évaluation des risques

)5-2:2024-09(en-fr)

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S12298Text Modification

IEC 62305-2

Edition 3.0 2024-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Protection against lightning –
Part 2: Risk management

Protection contre la foudre –
Partie 2: Évaluation des risques

INTERNATIONAL
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COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.020, 91.120.40 ISBN 978-2-8322-9549-6

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PROTECTION AGAINST LIGHTNING –

Part 2: Risk management

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 62305-2 has been prepared by IEC technical committee 81: Lightning protection. It is an International Standard.

This third edition cancels and replaces the second edition, published in 2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) The concept of a single risk, to combine loss of human life and loss due to fire, has been introduced.
b) The concept of frequency of damage that can impair the availability of the internal systems within the structure has been introduced.

c) The lightning ground strike-point density N_{SG} has been introduced replacing the lightning flash density N_G in the evaluation of expected average annual number of dangerous events.

d) Reduction of a few risk components can be achieved by the use of preventive temporary measures activated by means of a thunderstorm warning system (TWS) compliant with IEC 62793. The risk of direct strike to people in open areas has been introduced, considering the reduction of that risk using a TWS.

The text of this International Standard is based on the following documents:

Draft	Report on voting
81/769/FDIS	81/772/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62305 series, published under the general title *Protection against lightning*, can be found on the IEC website.

The following differing practices of a less permanent nature exist in the countries indicated below.

In Germany, the value of r_p = 1 applies for all cases. For the risk components R_B, R_C, R_M, R_V, R_W and R_Z P_{TWS} = 1 is assumed. For LF1 and LF2 the highest values given in Table C.2 should be used.

In Greece, the value of P_{TWS} = 1 for all cases is assumed.

In Italy, calculating both the risk of loss of human life, RL1 in Equation (7), and the risk of loss due to physical damages, RL2 in Equation (8), and comparing each risk with the tolerable risk is required. Protection is achieved when both risks, RL1 and RL2, are less than the tolerable value.

In the Netherlands and South Africa, Annex D and Annex E should not be applied for usual studies.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Lightning flashes to earth can be hazardous to structures and to lines supplying the structure.

These hazards can result in:

– damage to the structure and to its contents,
– failure of associated electrical and electronic systems,
– injury to living beings in or close to the structure.

Consequential effects of the damage and failures can be extended to the surroundings of the structure or can involve its environment. Moreover, regardless of the extent of loss, the availability of the structure and its internal systems can be unacceptably impaired if the frequency of damage is high.

To reduce the frequency of damage and the loss due to lightning, protection measures can be required. Whether they are necessary, and to what extent, should be determined by frequency of damage and risk assessment.

NOTE 1 The decision to provide lightning protection can be taken regardless of the outcome of frequency of damage or risk assessment where there is a desire that there be no avoidable damages.

NOTE 2 IEC 60364-4-44 [1][1] always requires the installation of a surge protective device (SPD) at the power line entrance in the structure when the consequence caused by overvoltages affects:

– care of human life, e.g. safety services, medical care facilities,
– public services and cultural heritage, e.g. loss of public services, IT centres, museums,
– commercial or industrial activity, e.g. hotels, banks, industries, commercial markets, farms.

The frequency of damage, defined in this document as the annual number of damages in a structure due to lightning flashes, depends on:

– the annual number of lightning flashes influencing the structure;
– the probability of damaging events by one of the influencing lightning flashes.

The risk, defined in this document as the probable average annual loss in a structure due to lightning flashes, depends on:

– the frequency of damage;
– the mean extent of consequential loss.

Lightning flashes influencing the structure can be divided into

– flashes terminating on the structure,
– flashes terminating near the structure, directly to connected lines (power, telecommunication lines) or near the lines.

Flashes to the structure or a connected line can cause physical damage and life hazards. Flashes near the structure or line as well as flashes to the structure or line can cause failure of electrical and electronic systems due to overvoltages resulting from resistive and inductive coupling of these systems with the lightning current.

Moreover, failures caused by lightning overvoltages in users' installations and in power supply lines can also generate voltage switching overvoltages in the installations.

NOTE 3 Malfunctioning of electrical and electronic systems is not covered by the IEC 62305 series. Reference is made to IEC 61000-4-5 [2].

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The number of lightning flashes influencing the structure depends on the dimensions, the characteristics of the structure and the connected lines, on the environmental characteristics of the structure and the lines, as well as on lightning ground strike-point density in the region where the structure and the lines are located. Guidance on the assessment of the number of lightning flashes influencing the structure is given in Annex A.

The probability of damage depends on the structure, the resistibility of equipment located on the structure, the connected lines, and the lightning current characteristics, as well as on the type and efficiency of the protection measures applied. Guidance on the assessment of probability of damage is given in Annex B.

The annual mean extent of the consequential loss depends on the extent of damage and the consequential effects which can occur as a result of a lightning flash. Guidance on the assessment of consequential loss is given in Annex C.

The effect of protection measures results from the characteristics of each protection measure and can reduce the damage probabilities.

NOTE 4 It is assumed that protective provisions are realized in the necessary quality.

The protection measures are intended to comply with the IEC 62305 series, the IEC 61643 series and IEC 62793, as applicable.

NOTE 5 For complex structures (such as petrochemical plants, large industrial plants) the factors reported in the annexes of this document can require more detailed evaluation of the characteristics of the structure.

National or local regulations can provide guidance or minimum requirements on the application of this document. This includes fixing the values for the tolerable risk R_T and the tolerable frequency of damage F_T, and the calculation rules and parameter values given in Annex A, Annex B, Annex C and Annex E.

PROTECTION AGAINST LIGHTNING –

Part 2: Risk management

1 Scope

This part of IEC 62305 is applicable to the risk management of a structure due to lightning flashes to earth.

Its purpose is to provide a procedure for the evaluation of such a risk. Once an upper tolerable limit for the risk has been selected, this procedure provides a means for the selection of appropriate protection measures to be adopted to reduce the risk to or below the tolerable limit.

Risk management also includes the evaluation of frequency of damage of internal systems caused by surges due to lightning flashes to earth. Once an upper tolerable limit for the frequency of damage has been selected, this procedure provides a means for the selection of appropriate protection measures to be adopted to reduce the frequency of damage to or below the tolerable limit.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61643 (all parts), *Low-voltage surge protective devices*

IEC 62305-1:2024 , *Protection against lightning – Part 1: General principles*

IEC 62305-3:2024, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

IEC 62305-4:2024, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

IEC 62793, *Thunderstorm warning systems – Protection against lightning*

IEC 62858, *Lightning density based on lightning location systems (LLS) – General principles*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
structure to be protected
any place, facility or building suitable to contain persons, animals, materials or systems

Note 1 to entry: A structure to be protected can be part of a larger structure.

3.2
structure with a risk of explosion
structures associated with hazardous areas as determined in accordance with IEC 60079-10-1 [3] and IEC 60079-10-2 [4] or solid explosive materials

Note 1 to entry: IEC 60079-10-1 and IEC 60079-10-2 do not deal with the hazards from solid explosives.

3.3
structure dangerous to the environment
structure which can cause biological, chemical or radioactive emission as a consequence of lightning

EXAMPLE Chemical, petrochemical plants.

3.4
urban environment
area with a high density of buildings or densely populated communities with tall buildings

EXAMPLE Town centre.

3.5
suburban environment
area with a medium density of buildings

EXAMPLE Town outskirts, residential communities.

3.6
rural environment
area with a low density of buildings

EXAMPLE Countryside.

3.7
rated impulse withstand voltage
U_W
value of the impulse withstand voltage assigned by the manufacturer to the equipment or to a part of it, characterizing the specified withstand capability of its insulation against overvoltages

Note 1 to entry: For the purposes of this document, only the withstand voltage between live conductors and earth is considered.

[SOURCE: IEC 60664-1:2020, 3.1.18 [5], modified – The symbol U_{imp} has been replaced with U_w, in the definition "transient overvoltages" has been replaced with "voltages" and the Note to entry has been added.]

3.8
electrical system
system incorporating low voltage power supply components

3.9
electronic system
system incorporating sensitive electronic components such as telecommunication equipment, computer, control and instrumentation systems, radio systems, power electronic installations

3.10
internal systems
electrical and electronic systems of a structure

3.11
line
power line or telecommunication line connected to the structure to be protected

3.12
telecommunication line
line intended for communication between equipment that can be located in separate structures

EXAMPLE Phones lines, data lines.

3.13
power line
distribution line feeding electrical energy into a structure to power electrical and electronic equipment located there

EXAMPLE Low voltage (LV) or high voltage (HV) electric mains.

3.14
dangerous event
lightning flash to or near the structure to be protected, or to or near a line connected to the structure to be protected that can cause damage

3.15
lightning flash to a structure
lightning flash striking a structure to be protected

3.16
lightning flash near a structure
lightning flash striking close enough to a structure to be protected that can cause dangerous overvoltages

3.17
lightning flash to a line
lightning flash striking a line connected to the structure to be protected

3.18
lightning flash near a line
lightning flash striking close enough to a line connected to the structure to be protected that can cause dangerous overvoltages

3.19
ground flash density
N_G
mean number of cloud-to-ground flashes per unit of area per unit of time (flashes × km^{-2} × year^{-1})

Note 1 to entry: Lightning flashes to ground can have more than one striking point to ground.

3.20
lightning ground strike-point density
N_{SG}
mean number of strike-points to ground or to ground based objects per unit of area per unit of time (strike-points × km^{-2} × year^{-1})

3.21
number of dangerous events due to flashes to a structure
N_D
expected average annual number of dangerous events due to lightning flashes to a structure

3.22
number of dangerous events due to flashes to a line
N_L
expected average annual number of dangerous events due to lightning flashes to a line

3.23
number of dangerous events due to flashes near a structure
N_M
expected average annual number of dangerous events due to lightning flashes near a structure

3.24
number of dangerous events due to flashes near a line
N_I
expected average annual number of dangerous events due to lightning flashes near a line

3.25
lightning electromagnetic pulse
LEMP
Fast time-varying electromagnetic field emitted by lightning and creating surges via resistive, inductive, capacitive and electromagnetic coupling to circuits

3.26
surge
transient created by lightning electromagnetic pulse (LEMP) coupled onto lines and equipment, that appears as an overvoltage or overcurrent

3.27
node
point on a line from which onward surge propagation can be assumed to be neglected

EXAMPLE A power HV substation for a power line, a telecommunication exchange for a telecommunication line.

3.28
physical damage
damage to a structure (or to its contents) due to mechanical, thermal, chemical or explosive effects of lightning

3.29
injury to human beings
injuries, including loss of life, to people resulting from lightning

Note 1 to entry: Animals are addressed by frequency of damage or loss L2.

3.30
failure of internal systems
damage of electrical and electronic systems due to LEMP

3.31
probability of damage
P
probability that a dangerous event will cause damage in the considered zone or to internal system of the structure to be protected

3.32
frequency of damage
F
value of the annual number of damaging events which can occur to internal systems of the structure to be protected

3.33
frequency of damage component
F_X
partial frequency of damage depending on the source of damage

3.34
tolerable frequency of damage
F_T
maximum value of the frequency of damage which can be tolerated by equipment inside the structure or a zone to be protected

3.35
loss
L_X
mean extent of a specified type of damage consequent to a dangerous event, in the considered zone of a structure

3.36
service
function performed by the internal systems of the structure to supply a specific need

3.37
risk
R
probable average annual loss due to lightning in a structure or in a considered zone of the structure

3.38
risk component
R_X
partial risk depending on the source and the type of damage

3.39
tolerable risk
R_T
maximum value of the risk which can be tolerated for the structure to be protected

3.40
risk zone
Z_X
<of a structure> part of a structure with homogeneous characteristics where a single set of parameters is applicable to the risk assessment

Note 1 to entry: A structure can contain one or more zones.

3.41
section of a line
S_L
part of a line with homogeneous characteristics where a single set of parameters is involved for that part of the line in the assessment of a risk or frequency of damage component

3.42
lightning protection zone
LPZ
zone where the lightning electromagnetic environment is defined

Note 1 to entry: The zone boundaries of an LPZ are not necessarily physical boundaries.

3.43
lightning protection level
LPL
number related to a set of lightning current parameters values relevant to the probability that the associated maximum and minimum design values will not be exceeded in naturally occurring lightning

Note 1 to entry: Lightning protection level is used to design protection measures according to the relevant set of lightning current parameters.

3.44
protection measures
measures adopted in the structure to be protected, in order to reduce the risk or frequency of damage

3.45
lightning protection
LP
measures taken for protection of structures against lightning, including their internal systems and contents, as well as persons, in general consisting of an LPS and SPM

Note 1 to entry: Ancillary protection measures such as a TWS can also be used.

3.46
lightning protection system
LPS
complete system used to reduce injury to living beings and physical damage due to lightning flashes to a structure

Note 1 to entry: A lightning protection system consists of both external and internal lightning protection systems.

3.47
surge protection measures
SPM
measures taken to protect internal systems against the effects of LEMP

Note 1 to entry: Surge protection measures are part of an overall lightning protection.

3.48
electromagnetic shield
screen of conductive material intended to reduce the penetration of a time-varying electromagnetic field into the structure or part of the structure to be protected, used to reduce failures of internal systems

3.49
lightning protective cable
special cable with a rated impulse withstand voltage greater than U_{w} of the connected equipment and a metallic sheath in continuous contact with the soil, either directly or by use of conductive plastic covering

3.50
lightning protective cable-duct
cable-duct of low resistivity in contact with the soil

EXAMPLE Concrete with interconnected structural steel reinforcements, metallic duct.

3.51
surge protective device
SPD
device that contains at least one non-linear component and that is intended to limit transient overvoltages and divert surge currents

[SOURCE: IEC 61643-11:2011, 3.1.1 [6], modified – "surge voltages" has been replaced with "transient overvoltages and the Note has been deleted.]

3.52
coordinated SPD system
system composed of SPDs properly selected, coordinated and installed to form a system intended to reduce the failures of electrical and electronic systems

3.53
isolating interface
device which is capable of reducing conducted surges on a line entering the lightning protection zone (LPZ)

Note 1 to entry: The isolating interface includes isolation transformers with earthed screen between windings, metal-free fibre optic cables and opto-isolators.

Note 2 to entry: The insulation withstand characteristics of a device suitable for this application is provided either intrinsically or via an SPD.

3.54
lightning equipotential bonding
EB
bonding to an LPS of separated metallic parts, by direct conductive connections or via surge protective devices, to reduce potential differences caused by lightning current

3.55
thunderstorm warning system
TWS
system composed of thunderstorm detector(s) able to monitor the lightning or upcoming lightning activity in the monitoring area (MA) and tools for processing the acquired data to provide a valid alarm (warning) related to the lightning-related events (LREs) or conditions (LRC) for a defined surrounding area (SA)

Note 1 to entry: Some countries refer to TWS as 'lightning warning systems'.

[SOURCE: IEC 62793:2020, 3.1.23]

3.56
lightning-related event
LRE
event where one or more cloud-to-ground lightning (CG) occurs inside the surrounding area (SA)

[SOURCE: IEC 62793:2020, 3.1.15]

3.57
lightning-related conditions
LRC
static electric field that has reached a level high enough so that lightning is expected to occur at any time in the surrounding area (SA)

[SOURCE: IEC 62793:2020, 3.1.16]

3.58
monitoring area
MA
geographic area where the lightning or upcoming lightning (lightning is expected to occur at any time) activity is monitored in order to provide a valid warning for the surrounding area (SA)

Note 1 to entry: The monitoring area is smaller or equal to the coverage area.

[SOURCE: IEC 62793:2020, 3.1.18]

3.59
surrounding area
SA
geographic area in which a lightning-related event (LRE) causes a potential danger and which surrounds and includes the target (TA) to be protected

Note 1 to entry: Any lightning-related event (LRE) occurring in the surrounding area (SA) is potentially dangerous for the target. This area is used when evaluating a thunderstorm warning system (TWS) to determine the performance parameters such as failure to warn ratio (FTWR).

[SOURCE: IEC 62793:2020, 3.1.20]

3.60
Zone 0
area in which an explosive gas atmosphere is present continuously, or for long periods, or frequently

Note 1 to entry: Both “long” and “frequently” are the terms which are intended to describe a very high likelihood of a potentially explosive atmosphere in the area. In that respect, those terms do not necessarily need to be quantified.

[SOURCE: IEC 60079-10-1:2020, 3.3.4 [3]]

3.61
Zone 1
area in which an explosive gas atmosphere is likely to occur occasionally in normal operation

[SOURCE: IEC 60079-10-1:2020, 3.3.5 [3]]

3.62
Zone 2
area in which an explosive gas atmosphere is not likely to occur in normal operation, but, if it does occur, will exist for a short period only

[SOURCE: IEC 60079-10-1:2020, 3.3.6 [3]]

3.63
Zone 20
a place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is present continuously, or for long periods, or frequently

[SOURCE: IEC 60079-10-2:2015, 3.25.1 [4]]

3.64
Zone 21
a place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is likely to occur in normal operation occasionally

[SOURCE: IEC 60079-10-2:2015, 3.25.2 [4]]

3.65
Zone 22
area in which an explosive dust atmosphere, in the form of a cloud of combustible dust in air, is not likely to occur in normal operation but, if it does occur, will persist for a short period only

Note 1 to entry: The potential of creating an explosive dust cloud from a dust layer also needs to be considered.

[SOURCE: IEC 60079-10-2:2015, 3.25.3 [4]]

3.66
adjacent structure
structure connected to the structure under review by at least one line

4 Symbols and abbreviated terms

A_{D}	Equivalent collection area for flashes to an isolated structure	A.2.1.2
A_{D}'	Collection area attributed to an elevated roof protrusion	A.2.1.3
A_{DJ}	Equivalent collection area for flashes to an adjacent structure	A.2.5
A_{I}	Equivalent collection area for flashes near a line	Clause A.5
A_{L}	Equivalent collection area for flashes to a line	Clause A.4
A_{M}	Equivalent collection area for flashes striking near the structure	Clause A.3
B	Building	A.2.2
C_{D}	Location factor	Table A.1
C_{DJ}	Location factor of an adjacent structure	A.2.5, Table A.1
C_{E}	Environmental factor	Table A.4
C_{I}	Installation factor of the line	Table A.2
C_{LD}	Factor depending on shielding, grounding and isolation conditions of the line for flashes to a line	Table B.9
C_{LI}	Factor depending on shielding, grounding and isolation conditions of the line for flashes near a line	Table B.9
C_{T}	Line type factor for a HV/LV transformer on the line	Table A.3
D_{1D}	Electric shock resulting from direct strike to human beings	5.2
D_{1T}	Electric shock to human beings resulting from resistive and inductive coupling	5.2
D_2	Dangerous sparking triggering fire or explosion.	5.2
D_3	Surges due to all sources of damage	5.2
F	Frequency of damage	9.1
F_{C}	Frequency of damage due to flashes to the structure (source S_1)	9.1
F_{M}	Frequency of damage due to flashes near the structure (source S_2)	9.1
F_{T}	Tolerable frequency of damage	9.3

L_{UT} Loss related to injury to human beings by electric shock resulting from resistive and inductive coupling (flashes to a line)... Clause C.2

L_{V1} Loss related to injury to human beings, caused by physical damage to a structure (flashes to a line) .... Clause C.2

L_{V2} Loss related to physical damage to a structure (flashes to a line) .... Clause C.2

L_{VT} Total loss related to physical damage of the structure including environmental damage (flashes to a line).. Clause C.2

L_{W1} Loss related to injury to human beings caused by failure of internal systems (flashes to a line).. Clause C.2

L_{W2} Loss related to failure of internal systems (flashes to a line) .... Clause C.2

L_X Loss consequent to damages..8.1

L_{Z1} Loss related to injury to human beings, caused by failure of internal systems (flashes near a line)... Clause C.2

L_{Z2} Loss related to failure of internal systems (flashes near a line) .... Clause C.2

n' Number of conductors in a cable...Table B.7

n Total number of cable conductors and external conducting paths......................Table B.7

N_D Number of dangerous events per year due to flashes to structure……………......... A.2.4

N_{DJ} Number of dangerous events due to flashes to adjacent structure.......................... A.2.5

N_G Annual lightning ground flash density...Clause A.1

N_I Number of dangerous events due to flashes near a line .... Clause A.5

N_L Number of dangerous events due to flashes to a line .... Clause A.4

N_M Number of dangerous events due to flashes near a structure..........................Clause A.3

N_{SG} Annual lightning ground strike-point density ....Clause A.1

N_X Number of dangerous events per annum..8.1, 9.2

P_{AD} Probability that a flash to a structure will strike a person.................................Clause B.3

P_{am} Probability that a flash to a structure will cause injury to human beings due to touch and step voltages ....Clause B.2

P_{AT} Probability that a flash to a structure will cause dangerous touch and step voltages ....Clause B.2

P_B Probability of physical damage to a structure (flashes to a structure)..............Clause B.4

P_C Probability of failure of internal systems (flashes to a structure)......................Clause B.5

P_e Probability that an equipment will be exposed to a damaging event ....Clause B.12

P_{EB} Probability that a spark between electrically-isolated conductive sections could appear in spite of protection by EB ....Clause B.7, Table B.13

P_{LD} Probability reducing P_U, P_V and P_W depending on-line characteristics and withstand voltage of equipment (flashes to connected line) ....Clause B.7

P_{LPS} Probability depending on LPL of lightning protection system (LPS) ....Clause B.3

P_M Probability of failure of internal systems (flashes near a structure).................Clause B.6

P_{MS} Probability reducing P_M depending on shielding, wiring and withstand voltage of equipment...Clause B.6

P_O Probability factor according to the position of a person in the exposed area ...Clause B.3

P_P	Probability that a person will be in a dangerous place	Clause B.11
P_Q	Probability that the value of the charge associated with the current flowing through the SPD is exceeding the value tolerated by the SPD	Annex D
P_S	Probability that a flash to a structure will cause dangerous sparking	Clause B.4
P_{SPD}	Probability that an apparatus will be damaged, in spite of protection by a coordinated SPD system	Table B.8, Table B.9
P_{TWS}	Probability that a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area	Clause B.1
P_U	Probability of injury to human beings by electric shock (flashes to a connected line)	Clause B.7
P_{Up}	Probability that the value of residual voltage at the SPD exceeds the required protection level U_p, relevant to the current flowing through the SPD	Annex D
P_V	Probability of physical damage to a structure (flashes to a connected line)	Clause B.8
P_W	Probability of failure of internal systems (flashes to connected line)	Clause B.9
P_X	Probability of damage	8.1, 9.2
P_Z	Probability of failure of internal systems (flashes near a connected line)	Clause B.10
r_f	Factor reducing loss depending on risk of fire	Clause B.4
r_M	Conventional distance	Clause A.3, Clause A.5
r_p	Factor reducing the loss due to provisions against fire	Clause B.4
r_t	Reduction factor associated with the type of surface	Clause B.2
R	Risk	6.1, 6.3.1, 6.3.2
R_{AD}	Risk component (injury caused by a flash to human beings exposed on a structure – flashes to a structure)	6.2.1, Table 2, Table 3
R_{AT}	Risk component (injury to human beings caused by electric shock due to touch and step voltages – flashes to a structure)	6.2.1, Table 2, Table 3
R_B	Risk component (physical damage to a structure – flashes to a structure)	6.2.1, Table 2, Table 3
R_C	Risk component (failure of internal systems – flashes to a structure)	6.2.1, Table 2, Table 3
R_M	Risk component (failure of internal systems – flashes near a structure)	6.2.2, Table 2, Table 3
R_S	Shield resistance per unit length of a cable	Table B.12, Table B.13
R_T	Tolerable risk	7.3
R_U	Risk component (injury to human being – flashes to a connected line)	6.2.3, Table 2, Table 3
R_V	Risk component (physical damage to a structure – flashes to a connected line)	6.2.3, Table 2, Table 3
R_W	Risk component (failure of internal systems – flashes to a connected line)	6.2.3, Table 2, Table 3
R_X	Risk component for a structure	8.1
R_Z	Risk component (failure of internal systems – flashes near a line)	6.2.4, Table 2, Table 3
S	Structure	A.2.2

S2	Source of damage – Flashes near a structure	5.1, Table 3
S3	Source of damage – Flashes to a line	5.1, Table 3
S4	Source of damage – Flashes near a line	5.1, Table 3
S_L	Section of a line	8.4
t_z	Time in hours per year that persons are present in a dangerous place	Clause B.11
U_W	Rated impulse voltage of a system	Clause A.3, Clause A.5, Clause B.7
w_m	Mesh width	Clause B.6
W	Width of structure	A.2.1.2
X	Generic subscript for risk component, number of dangerous events, probability and loss	8.1, 9.2
Z_S	Zones of a structure	8.3

5 Damage and loss

5.1 Source of damage

The lightning current is the primary source of damage. Details relating to lightning currents and lightning properties shall be taken into consideration, in accordance with IEC 62305-1:2024. The following sources are distinguished by the point of strike:

S1: flashes to the structure,

S2: flashes near the structure,

S3: flashes to a line connected to the structure,

S4: flashes near a line connected to the structure.

5.2 Cause of damage

A lightning flash can cause damage in different ways depending on the characteristics of the structure being assessed. Some of the most important characteristics are: type of construction, contents and application, type of service and protection measures provided. Physical damage to structures and life hazards shall be taken into consideration, in accordance with IEC 62305-3:2024.

As a result, four causes of damage can be distinguished:

- D_{1D}: electric shock to human beings resulting from direct strike to those beings;
- D_{1T}: electric shock to human beings resulting from resistive and inductive coupling;
- D_2: dangerous sparking inside the structure either triggering fire or explosion or leading to mechanical and chemical effects, or both, which can also endanger the environment;
- D_3: surges due to all sources of damage causing failures of internal systems.

The damage to a structure due to lightning can be limited to a part of the structure or can extend to the entire structure. It can also involve surrounding structures or the environment (structures dangerous to the environment).

5.3 Type of loss

Each cause of damage relevant to a structure to be protected, alone or in combination with others, can produce different types of loss. The type of loss that can appear depends on the characteristics of the structure itself.

For the purposes of this document, the following types of loss, which can appear as a consequence of lightning flashes, are considered:

L_1: loss due to injury to human beings. It is a consequence of causes D_{1D}, D_{1T}, D_2 and even D_3 in structures where failure of internal systems endangers human life for example in structures with a risk of explosion and hospitals;

L_2: loss due to physical damage of the structure and its contents. It is a consequence of causes D_2 and D_3 (D_3 generally for structures with a risk of explosion);

L_3: loss due to failure of internal systems. It is a consequence of cause D_3.

NOTE 1 L_3 does not address physical damage to an internal system. It is focused on surges affecting the function provided by the internal system.

The risk calculation is applicable to all structures when types of loss L_1 or L_2 are involved.

The type of loss L_3 can unacceptably impair the services provided by internal systems of the structure. In this case the frequency of damage calculation is performed in addition to the risk calculation. Frequency of damages can cover pure economic losses or loss of service. When damage to internal systems implies consequences for the environment or involves safety related critical equipment, consequence of losses should be addressed by risk calculation and not frequency of damage. Protection against lightning for electrical and electronic systems within structures shall be taken into consideration, in accordance with IEC 62305-4:2024 and the IEC 61643 series.

NOTE 2 Loss of national heritage is covered by loss L_2, loss of service to the public is covered by F and L_2/L_3.

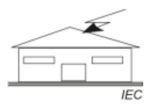
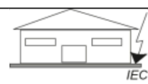
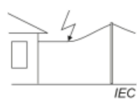
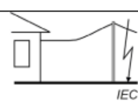
6 Risk and risk components

6.1 Risk

The risk R shall be evaluated with reference to the safety of persons (type of loss L_1) and of the structure and its content (type of loss L_2).

To evaluate risk R, the risk components (partial risks depending on the source of damage and type of loss) shall be defined and calculated (see Table 1).

Table 1 – Sources of damage, causes of damage, types of loss and risk components according to the point of strike

Point of strike		Source of damage	Cause of damage	Type of loss	Risk component
The structure		S1	D_{1T}	L_1	R_{AT}
			D_{1D} [c]	L_1	R_{AD}
			D_2	L_1, L_2	R_{B1}, R_{B2}
			D_3	L_1[a], L_2[b]	R_{C1}, R_{C2}
Near the structure		S2	D_3	L_1[a], L_2[b]	R_{M1}, R_{M2}
The lines connected to the structure		S3	D_{1T}	L_1	R_U
			D_2	L_1, L_2	R_{V1}, R_{V2}
			D_3	L_1[a], L_2[b]	R_{W1}, R_{W2}
Near the lines connected to the structure		S4	D_3	L_1[a], L_2[b]	R_{Z1}, R_{Z2}

Risk components in the last column are calculated based on the type of losses considered (see column Type of loss).

[a] Generally for structures where failure of internal systems endangers human life for example in structures with risk of explosion and hospitals.

[b] Generally for structures with a risk of explosion.

[c] This is only for people exposed on a structure such as parking on a roof or terrace, balconies.

Some examples of risk calculations are reported in Annex F.

6.2 Risk components

6.2.1 Risk components for a structure due to source S1

R_{AT}: Component related to type of loss L_1, caused by electric shock to human beings due to touch and step voltages inside the structure and outside in zones up to 3 m around down conductors.

R_{AD}: Component related to type of loss L_1, caused by a flash to human beings exposed on a structure.

R_B: Component related to type of loss L_1 (R_{B1}) and L_2 (R_{B2}), caused by dangerous sparking inside the structure triggering fire or explosion, or leading to mechanical or chemical effects, which can also endanger the environment.

R_C: Component related to type of loss L_1 (R_{C1}) and L_2 (R_{C2}), caused by failure of internal systems because of LEMP. Loss can occur generally in the case of structures with a risk of explosion and of hospitals or other structures where failure of internal systems involve injury to human beings or danger to the environment.

6.2.2 Risk component for a structure due to source S2

R_M: Component related to type of loss L_1 (R_{M1}) and L_2 (R_{M2}), caused by failure of internal systems due to LEMP. Loss can occur in the case of structures with a risk of explosion and of hospitals or other structures where failure of internal systems involve injury to human beings or danger to the environment.

6.2.3 Risk components for a structure due to source S3

R_U: Component related to type of loss L_1, caused by electric shock to human beings due to touch voltages inside the structure.

R_V: Component related to type of loss L_1 (R_{V1}) and L_2 (R_{V2}), caused by fire or explosion (triggered by dangerous sparking between an external installation and metallic parts generally at the entrance point of the line into the structure) or leading to mechanical or chemical effects, due to lightning current transmitted through or along incoming lines.

R_W: Component related to type of loss L_1 (R_{W1}) and L_2 (R_{W2}), caused by failure of internal systems by overvoltages induced on incoming lines and transmitted to the structure. Loss can occur generally in the case of structures with a risk of explosion and of hospitals or other structures where failure of internal systems involve injury to human beings or danger to the environment.

NOTE 1 All lines which are connected to the structure are considered in the assessment.

NOTE 2 Lightning flashes to or near metallic pipes are considered as a source of damage unless the pipes are bonded to an equipotential bonding bar or the LPS earthing system at the entrance of the structure.

6.2.4 Risk component for a structure due to source S4

R_Z: Component related to type of loss L_1 (R_{Z1}) and L_2 (R_{Z2}), caused by failure of internal systems by overvoltages induced on incoming lines and transmitted to the structure. Loss can occur generally in the case of structures with a risk of explosion and of hospitals or other structures where failure of internal systems involve injury to human beings or danger to the environment.

NOTE 1 All lines which are connected to the structure are considered in the assessment.

NOTE 2 Lightning flashes to or near metallic pipes are considered as a source of damage unless the pipes are bonded to an equipotential bonding bar or the LPS earthing system at the entrance of the structure.

6.2.5 Factors affecting risk components for a structure

Characteristics of the structure, possible protection measures and provisions taken when a thunderstorm occurs are factors affecting risk components for a structure. The main factors are given in Table 2.

Table 2 – Factors influencing the risk components

Characteristics of structure or of internal systems – Protection measures	R_{AT}[h]	R_{AD}[h]	R_B[h]	R_C[h]	R_M	R_U	R_V	R_W	R_Z
Collection area	X	X	X	X	X	X	X	X	X
Surface soil resistivity	X								
Floor resistivity	X					X			
Physical restrictions, insulation, warning notice, soil equipotentialization	X					X			
Construction characteristics of structure	X		X						
LPS	X	X	X	X	X[a]	X[b]	X[b]		
Equipotential bonding SPD	X		X			X	X		
Isolating interfaces				X[c]	X[c]	X	X	X	X
Coordinated SPD system[f]				X	X			X	X
Spatial shield				X	X				
Shielding external lines						X	X	X	X
Shielding internal lines				X	X				
Routing precautions				X	X				
Bonding network				X					
Fire precautions			X				X		
Fire sensitivity			X				X		
Impulse withstand voltage				X	X	X	X	X	X
Thunderstorm warning systems[g]	X[d]	X[e]		X	X	X[e]	X[e]	X[e]	X[e]
Presence of people	X	X	X	X	X	X	X	X	X

NOTE Equipment is usually connected to two different services e.g. power line and data line. In case of equipment connected only to one service, the result can overestimate the risk.

[a] Only for grid-like external LPS acting as a shield (see KS1 factor in Annex B).

[b] Due to equipotential bonding.

[c] Only if they belong to equipment.

[d] Only for external risk zones according to provisions activated by means of a thunderstorm warning system (TWS) compliant with IEC 62793. A TWS shall always be active and running and should send a message in case of fault.

[e] According to provisions activated by means of a thunderstorm warning system (TWS) compliant with IEC 62793.

[f] Mainly for structures where failure of internal systems endangers human life for example in structures with a risk of explosion and hospitals.

[g] The provisions taken shall be appropriate for the case investigated.

[h] When source of damage S1 is considered, protection measures are effective only in structures protected by an LPS or structures with continuous metal or reinforced concrete framework acting as a natural LPS.

6.3 Composition of risk components

6.3.1 Composition of risk components according to source of damage

The risk R is the sum of its risk components according to the source of damage or type of loss.

$$R = R_{S1} + R_{S2} + R_{S3} + R_{S4} \quad (1)$$

where

$$R_{S1} = R_{AT} + R_{AD} + R_{B1} + R_{B2} + R_{C1} + R_{C2} \quad (2)$$

$$R_{S2} = R_{M1} + R_{M2} \quad (3)$$

$$R_{S3} = R_{U} + R_{V1} + R_{V2} + R_{W1} + R_{W2} \quad (4)$$

$$R_{S4} = R_{Z1} + R_{Z2} \quad (5)$$

R_{C1}, R_{M1}, R_{W1} and R_{Z1} generally apply for structures with a risk of explosion and for hospitals with life-saving electrical equipment or other structures when failure of internal systems involve injury to human beings or danger to the environment.

R_{C2}, R_{M2}, R_{W2} and R_{Z2} generally apply for structures with a risk of explosion.

NOTE 1 An analysis can justify that an equipment damaged by an overvoltage can create a fire or explosion inside the building. In this case, the relevant risk components can also be evaluated in the risk assessment.

NOTE 2 The value of risk R obtained by adding the two risk components R_M and R_Z is overestimated. In power internal systems the risk component R_M is usually negligible. A more accurate assessment of risk can be made by taking into account that a flash to ground simultaneously has influence on internal systems by direct inductive coupling and on the overvoltage induced on the connected lines. The effect is that components R_M and R_Z can overlap.

6.3.2 Composition of risk components according to type of loss

$$R = R_{L1} + R_{L2} \quad (6)$$

where

$$R_{L1} = R_{AT} + R_{AD} + R_{B1} + R_{C1} + R_{M1} + R_{U} + R_{V1} + R_{W1} + R_{Z1} \quad (7)$$

$$R_{L2} = R_{B2} + R_{C2} + R_{M2} + R_{V2} + R_{W2} + R_{Z2} \quad (8)$$

R_{C1}, R_{M1}, R_{W1} and R_{Z1} generally apply for structures with a risk of explosion and for hospitals with life-saving electrical equipment or other structures when failure of internal systems involve injury to human beings or danger to the environment.

R_{C2}, R_{M2}, R_{W2} and R_{Z2} mainly apply for structures with a risk of explosion.

NOTE 1 An analysis can justify that an equipment damaged by an overvoltage can create a fire or explosion inside the building. In this case, the relevant risk components can also be evaluated in the risk assessment.

NOTE 2 The value of risk R obtained by adding the two risk components R_M and R_Z is overestimated. In power internal systems the risk component R_M is usually negligible. A more accurate assessment of risk can be made by taking into account that a flash to ground simultaneously has influence on internal systems by direct inductive coupling and on the overvoltage induced on the connected lines. The effect is that components R_M and R_Z can

NOTE 3 Equations (7) and (8) provide the means of separately assessing the contribution of the risk of loss of human life and of the risk of loss of goods and services to the overall risk.

7 Risk assessment

7.1 Basic procedure

The following procedure shall be applied:

– identification of the structure to be assessed and its characteristics;
– evaluation of risk R.

7.2 Structure to be considered for risk assessment

The structure to be considered includes:

– the structure itself;
– installations in the structure;
– contents of the structure;
– persons in the structure, on the roof of the structure or in the zones up to 3 m from the outside of the structure;
– environment affected by damage to the structure.

Lines outside the structure are of relevance only to the extent that they can carry damaging currents into the structure.

NOTE The structure to be considered can be subdivided into several risk zones (see 8.3).

7.3 Procedure to evaluate the need of protection for risk *R*

Protection against lightning is necessary if the risk R is higher than the tolerable level R_T.

$$R > R_T$$

In this case, protection measures shall be adopted in order to reduce the risk R to no more than the tolerable level R_T.

$$R \leq R_T$$

NOTE 1 A representative value of tolerable risk is $R_T = 10^{-5}$ [year]$^{-1}$. Different values can be assigned after detailed investigation, taking into account the vulnerability of human beings inside and outside the investigated structure and the criticality of the structure and its environment for the public due to physical damage.

NOTE 2 When a risk evaluation is not otherwise required, evaluating whether or not to reduce the risk R can be decided by the owner or the manager of the structure.

NOTE 3 If $R \leq R_T$, lightning protection is not necessary to reduce the risk but can be:

– useful to reduce the frequency of damage of the internal systems (see 9.4);
– appropriate if it is desired to reduce in any way the loss (or the unavailability of services).

The following steps shall be taken to determine whether the risk exceeds the tolerable level:

– identification of the components R_X which make up the risk;
– calculation of the identified risk components R_X;
– calculation of the total risk R (see 6.3);
– comparison of the risk R with the tolerable value R_T

If the structure is partitioned in risk zones Z_S (see 8.3), risk R shall be evaluated for each zone Z_S.

Comparison of risk R with R_T shall be performed:

- for each risk zone of the structure in a zoned structure;
- for the whole structure in a single-zoned structure.

The procedure to evaluate the need for protection for risk R is given in Figure 1.

NOTE 4 When source of damage S1 is considered, protection measures are effective only in structures protected by an LPS or structures with continuous metal or reinforced concrete framework acting as a natural LPS.

NOTE 5 The site owner is informed in cases where the risk cannot be reduced to a tolerable level in spite of having applied the most efficient protection measures proposed. If the risk can be significantly reduced by temporary preventive measures, then a TWS according to IEC 62793 can be installed.

An assessment should be made when the damage to a structure due to lightning can also involve surrounding structures or the environment (e.g. fire propagation, explosion, chemical or radioactive emissions).

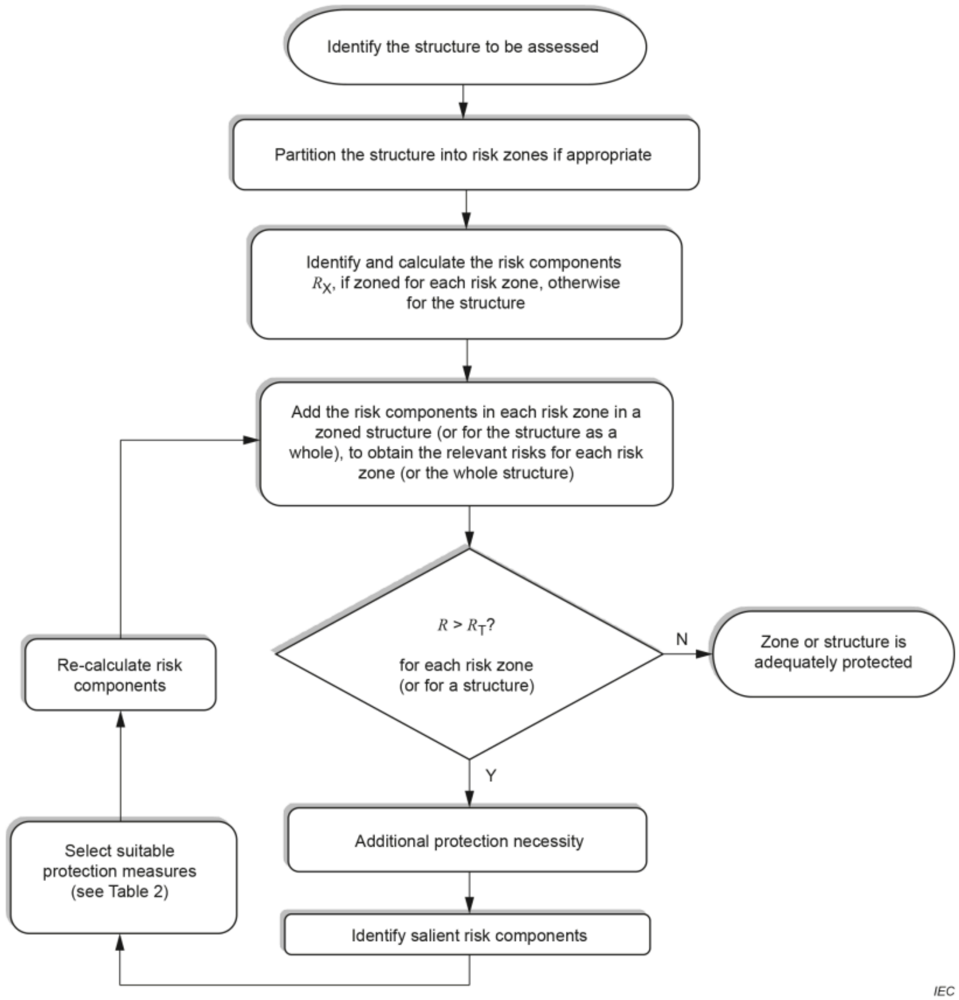


Figure 1 – Procedure for deciding the need for protection and for the selection of protection measures to reduce $R \leq R_T$

8 Assessment of risk components

8.1 Basic equation

Each risk component R_{AT}, R_{AD}, R_B, R_C, R_M, R_U, R_V, R_W and R_Z, as described in Table 3, can be expressed by the following general equation:

$$R_X = N_X \times P_X \times L_X \tag{9}$$

where

N_X is the number of dangerous events per annum (see also Annex A);

P_X is the probability of damage (see also Annex B);

L_X is the extent of consequent loss (see also Annex C).

The number N_X of dangerous events is affected by lightning ground strike-point density (N_{SG}) and by the physical characteristics of the structure to be protected, its surroundings, connected lines and the soil. N_X shall be obtained, as explained in detail in Annex A, mainly from LLS data, where LLS shall comply with IEC 62858.

The probability of damage P_X is affected by characteristics of the structure to be protected, the connected lines, the attendance of persons and the protection measures provided.

The consequent loss L_X is affected by the use to which the structure is assigned.

If the structure is partitioned in risk zones Z_S (see 8.3), each risk component shall be evaluated for each risk zone Z_S.

NOTE When the damage to a structure due to lightning can also involve surrounding structures or the environment (e.g. chemical or radioactive emissions), the consequent loss is added to the value of L_X, or the concept described in Annex E can be used.

8.2 Assessment of risk components due to different sources of damage

Equations to calculate the risk components related to each source of damage are given in Table 3.

The values of the parameters required in making the calculation of risk components can be found in Annex A, Annex B and Annex C.

For evaluation of the risk components related to lightning flashes to an incoming line (S3), the following shall be considered:

- If the line has more than one section (see 8.4), the values of R_U, R_V and R_W are the sum of the R_U, R_V and R_W values relevant to each section of the line. The sections to be considered are those between the structure and the first node. When information of the section lengths is not available, a maximum line length of 1 km for the sum of HV power lines and LV power lines and a maximum line length of 1 km for telecom lines can be assumed.
- In the case of a structure with more than one connected line with different routing feeding the same internal system, the calculations shall be performed for each line.
- In the case of a structure with more than one connected line with the same routing feeding the same apparatus, the calculations shall be performed only for the line leading to the highest values of N_L (telecom line versus power line, unscreened line versus screened line, LV power line versus HV power line with HV/LV transformer, etc.).

NOTE In the case of lines for which there is an overlapping of the collection area, the overlapping area is considered only once.

For evaluation of the risk component related to lightning flashes near a line connected to the structure (S4), the following shall be considered:

- If the line has more than one section (see 8.4), the value of R_Z is the sum of the R_Z components relevant to each section of the line. The sections to be considered are those between the structure and the first node. When information of the section lengths is not available, a maximum line length of 1 km for the sum of HV power lines and LV power lines and a maximum line length of 1 km for telecom lines can be assumed.
- In the case of a structure with more than one connected line with different routing feeding the same internal system, the calculations shall be performed for each line.
- In the case of a structure with more than one connected line with the same routing feeding the same internal system, the calculations shall be performed only for the line leading to the highest values of N_I (e.g. telecom line versus power line, unscreened line versus screened line, LV power line versus HV power line with HV/LV transformer, etc.).

If the structure is partitioned in risk zones Z_S (see 8.3), each risk component shall be evaluated for each risk zone Z_S.

Table 3 – Risk components for different sources of damage and types of loss

Type of loss	Source of damage			
	S1 **Lightning flash to a structure**	**S2** **Lightning flash near a structure**	**S3** **Lightning flash to an (incoming) line**	**S4** **Lightning flash near a line**
L_1 Injury to living beings	R_{AT} $= N_D \times P_{AT} \times P_P \times L_{AT}$		R_U $= (N_L + N_{DJ}) \times P_U \times P_P \times L_{UT}$	
	R_{AD} $= N_D \times P_{AD} \times P_P \times L_{AD}$			
	R_{B1} $= N_D \times P_B \times P_P \times L_{B1}$		R_{V1} $= (N_L + N_{DJ}) \times P_V \times P_P \times L_{V1}$	
	R_{C1} $= N_D \times P_C \times P_P \times P_e \times L_{C1}$ See footnote "a".	R_{M1} $= N_M \times P_M \times P_P \times P_e \times L_{M1}$ See footnote "a".	R_{W1} $= (N_L + N_{DJ}) \times P_W \times P_P \times P_e \times L_{W1}$ See footnote "a".	R_{Z1} $= N_I \times P_Z \times P_P \times P_e \times L_{Z1}$ See footnote "a".
L_2 Physical damage	R_{B2} $= N_D \times P_B \times L_{B2}$		R_{V2} $= (N_L + N_{DJ}) \times P_V \times L_{V2}$	
	R_{C2} $= N_D \times P_C \times P_e \times L_{C2}$ See footnote "b".	R_{M2} $= N_M \times P_M \times P_e \times L_{M2}$ See footnote "b".	R_{W2} $= (N_L + N_{DJ}) \times P_W \times P_e \times L_{W2}$ See footnote "b".	R_{Z2} $= N_I \times P_Z \times P_e \times L_{Z2}$ See footnote "b".

[a] R_{C1}, R_{M1}, R_{W1} and R_{Z1} generally apply for structures with a risk of explosion and for hospitals or other structures where failures of internal systems immediately endanger human life.

[b] R_{C2}, R_{M2}, R_{W2} and R_{Z2} generally apply for structures with a risk of explosion.

8.3 Partitioning of a structure in risk zones Z_S

To assess each risk component, a structure can be (or is assumed to be) a single zone or can be divided into risk zones Z_S each having their own homogeneous characteristics.

Risk zones Z_S are generally defined by:

- type of soil or of floor;
- fireproof compartments;
- spatial shields.

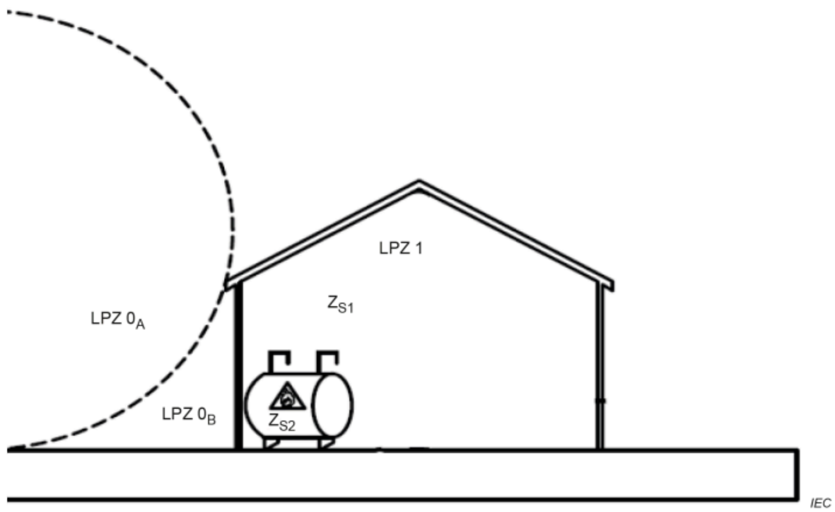
Further risk zones can be defined according to:

- layout of internal systems;
- protection measures existing or to be provided;
- loss L_X values.

Partitioning of the structure in risk zones Z_S should take into account the feasibility of the implementation of the most suitable protection measures.

NOTE It is emphasized that the risk zones Z_S are defined by the designer to carry out the risk assessment. They are different from the zones LPZ defined in IEC 62305-1.

An example of zone partitioning is shown in Figure 2.



Key

LPZ 0_A	direct flash, full lightning current, full electromagnetic field
LPZ 0_B	no direct flash, lightning or induced current, full electromagnetic field
LPZ 1	no direct flash, limited lightning or induced current, damped electromagnetic field H1 present (Zone where the surge current is limited by current sharing and isolating interfaces or by SPDs at the boundary. Spatial shielding can attenuate the lightning electromagnetic field.)
Z_{S1}	example of zone number 1
Z_{S2}	example of zone number 2

Figure 2 – Example of zone partitioning

8.4 Partitioning of a line into sections S_L

To assess the risk components due to a flash to or near a line, the line can be assumed to be a single section or can be divided into individual sections S_L.

For all risk components, sections S_L are primarily defined by

– the type of line (aerial or buried, C_I),
– the characteristics of the line (shielded or unshielded, shield resistance),
– other factors (C_D, C_E, C_T).

If more than one value of a parameter exists in a section, the value leading to the highest value of risk shall be assumed.

8.5 Assessment of risk components in a zone of a structure with risk zones Z_S

8.5.1 General criteria

For the evaluation of risk components and the selection of the relevant parameters involved, the following rules apply:

– parameters relevant to the number N of dangerous events shall be evaluated according to Annex A;

– parameters relevant to the probability P of damage shall be evaluated according to Annex B.

Moreover:

– for components R_A, R_{B1}, R_{B2}, R_U, R_{V1}, R_{V2}, R_{W1}, R_{W2}, R_{Z1}, and R_{Z2}, only one value shall be fixed in each risk zone for each parameter involved. Where more than one value is applicable, the highest one shall be chosen;

– for components R_{C1}, R_{C2}, R_{M1}, and R_{M2}, if more than one internal system is involved in a risk zone, values of P_C and P_M are given by:

$$P_C = 1 - (1 - P_{C1}) \times (1 - P_{C2}) \times \ldots \times (1 - P_{Cn}) \tag{10}$$

$$P_M = 1 - (1 - P_{M1}) \times (1 - P_{M2}) \times \ldots \times (1 - P_{Mn}) \tag{11}$$

where P_{Cn} and P_{Mn} are parameters relevant to the internal system n = 1, 2, 3…;

– parameters relevant to the loss shall be evaluated according to Annex C.

With the exception made for P_C and P_M, if more than one value of any other parameter exists in a risk zone, the value of the parameter leading to the highest value of risk is to be assumed.

NOTE 1 An internal system is not necessarily connected directly to an external service. For example, it can be connected to a copper power line and to a data line connected via an isolation interface.

NOTE 2 A simpler approach is to use $P_C = P_{C1}$ and $P_M = P_{M1}$ where P_{C1} and P_{M1} refer to the worst case.

8.5.2 Single-zoned structure

In this case, only one risk zone Z_S defines the entire structure. The risk R is the sum of risk components R_X in this risk zone.

Defining the structure with a single risk-zone can lead to a greater expense than necessary if an expensive protection measure shall extend to the entire structure, even though it is not essential throughout the entire structure.

8.5.3 Multi-zoned structure

In this case, the structure is divided into multiple risk zones Z_S. In each risk zone, the risk is the sum of all relevant risk components in the risk zone.

Dividing a structure into risk zones allows the designer to take into account the characteristics of each part of the structure in the evaluation of risk components and to select the most suitable protection measures tailored to each risk zone, reducing the overall cost of protection against lightning.

9 Frequency of damage and its components

9.1 Frequency of damage

The frequency of damage F is the value of the number of damaging events caused by sources of damage S in the systems of the structure to be protected.

In the evaluation of the need of protection against lightning, the frequency of damage F shall be considered with reference to loss of service L_3.

The frequency of damage F is the sum of partial frequencies of damage depending on the source of damage. For evaluation of the frequency of damage F the following relationship applies:

$$F = F_C + F_M + F_W + F_Z \tag{12}$$

where

F_C is the frequency of damage due to flashes to the structure (source S1);

F_M is the frequency of damage due to flashes near the structure (source S2);

F_W is the frequency of damage due to flashes to the line (source S3);

F_Z is the frequency of damage due to flashes near the line (source S4).

The frequency of damages F_C refers to the failure of internal systems caused by LEMP and earth potential rise due to flashes to the structure, F_M refers to the failure of internal systems caused by LEMP due to flashes to ground near the structure, whereas the frequency of damages F_W and F_Z refers to the failure of internal systems caused by overvoltages transmitted from incoming lines to the structure.

NOTE 1 The value of frequency of damage F obtained by adding the two partial frequencies of damage F_M and F_Z can be overestimated. A more accurate assessment of risk can be made by taking into account that a flash to ground simultaneously has influence on internal systems by direct inductive coupling and on the overvoltage induced on the connected lines. The effect is that partial frequency of damage F_M and F_Z can overlap.

NOTE 2 In power internal systems the frequency component F_M is usually negligible.

NOTE 3 The frequency of damage caused by lightning flashes associated with a structure can be assessed for a piece of equipment. The frequency of damage of an internal system or a part of an internal system is in all cases the one of its weakest equipment amongst equipment the user wants to protect (by default all of them).

9.2 Assessment of partial frequency of damage

Each partial frequency of damage F_C, F_M, F_W and F_Z, as described in 9.1, can be expressed by the following general equation:

$$F_X = N_X \times P_X \tag{13}$$

where

N_X is the number of dangerous events per annum (see also Annex A);

P_X is the probability of damage (see also Annex B);

Equations to calculate the partial frequency of damage related to each source of damage are given in Table 4.

The values of the parameters required in making the calculation of partial frequency of damage are given in Annex A and Annex B. Where TWSs are involved, as explained in detail in Annex B, these shall comply with IEC 62793.

Table 4 – Partial frequency of damage for each source of damage

Type of loss	Source of damage			
	S1 Lightning flash to a structure	**S2 Lightning flash near a structure**	**S3 Lightning flash to an (incoming) line**	**S4 Lightning flash near a line**
L_3 loss of service due to failure of internal systems	$F_C = N_D \times P_C \times P_e$	$F_M = N_M \times P_M \times P_e$	$F_W = (N_L + N_{DJ}) \times P_W \times P_e$	$F_Z = N_I \times P_Z \times P_e$

9.3 Procedure to evaluate the need of protection for frequency of damage F

Protection against lightning is necessary if the frequency of damage F is higher than the tolerable level F_T

$$F > F_T$$

In this case, protection measures should be adopted in order reduce the frequency of damage F to no more than the tolerable level F_T

$$F \leq F_T$$

NOTE 1 A representative value of tolerable risk F_T is F_T = 0,1 [year]$^{-1}$ for internal systems critical in performing their function in relation to the required service unavailability, and F_T = 1 [year]$^{-1}$ for non-critical internal systems. The values F_T = 0,1 and F_T = 1 proposed in this document are typical values of tolerable frequency of damage.

NOTE 2 The criticality of the internal systems to perform their function (in relation to the service unavailability that can be tolerated) is considered by the owner or manager of the structure when fixing the F_T value.

NOTE 3 If $F \leq F_T$, lightning protection is not necessary to reduce frequency of damage, but can be appropriate if it is desired to reduce in any way the loss or the unavailability of services.

The following steps shall be taken to evaluate the need of protection for frequency of damage F:

– calculation of the partial frequency of damage F_X;
– calculation of the total frequency of damage F;
– identification of the tolerable frequency of damage F_T;
– comparison of the frequency of damage F with the tolerable value F_T.

The frequency of damage F shall be evaluated for internal systems or equipment in the structure that the owner wants to protect (when the structure is divided into zones, in each zone where equipment is located and that the owner or manager wants to protect). Comparison of frequency F with F_T shall be performed for these internal systems or equipment.

The procedure to evaluate the need for protection for the frequency of damage F is given in

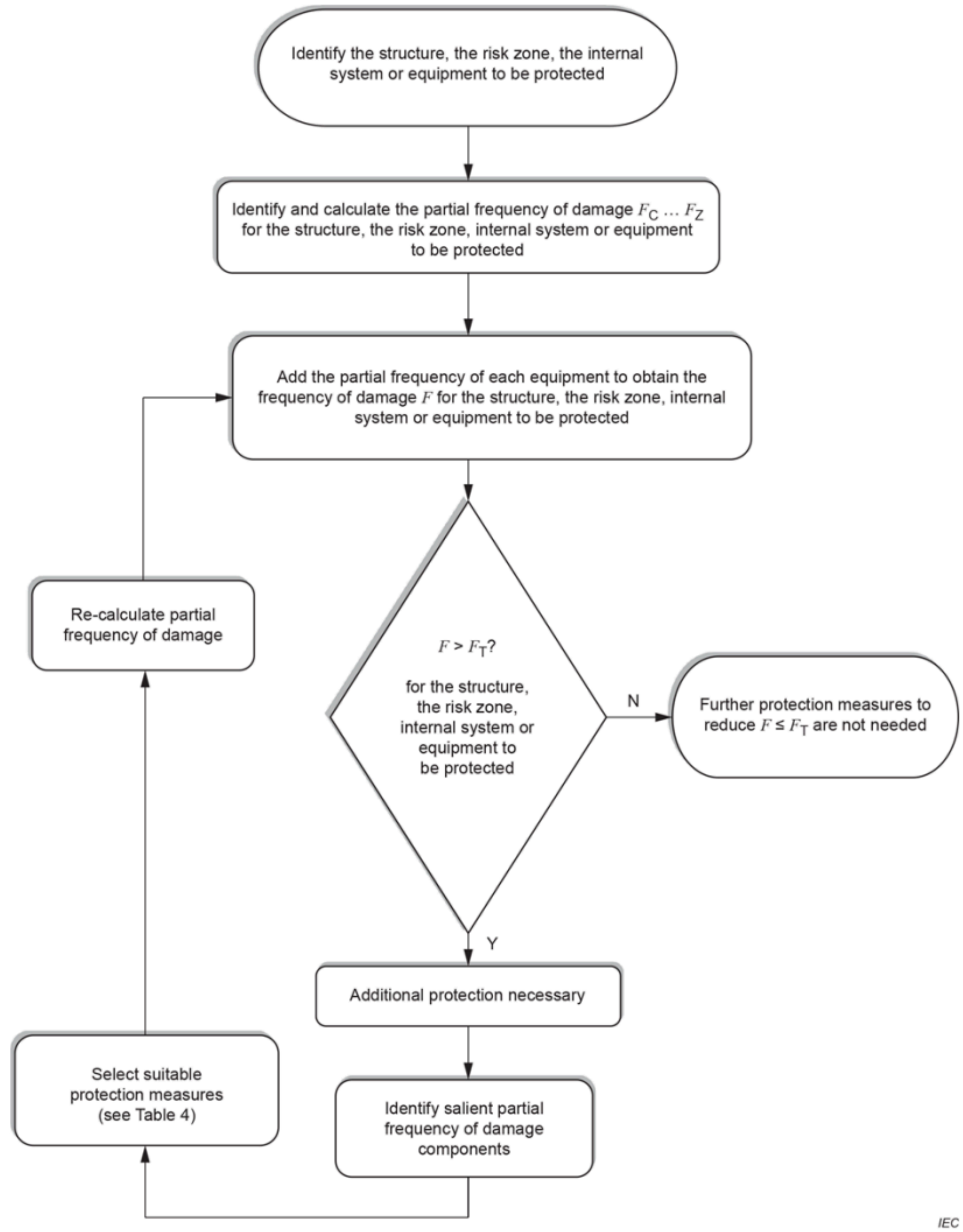


Figure 3 – Procedure for determining the need for protection and for the selection of protection measures

9.4 Assessment of partial frequency of damage in zones

9.4.1 General criteria

For the evaluation of partial frequency of damage and the selection of the relevant parameters involved, the following rules apply:

– parameters relevant to the number N of dangerous events shall be evaluated according to Annex A;

– parameters relevant to the probability P of damage shall be evaluated according to Annex B.

Moreover:

– for partial frequency of damage F_W and F_Z, only one value is to be fixed in each risk zone for each parameter involved. Where more than one value is applicable, the highest one shall be chosen;

– for partial frequency of damage F_C and F_M, if more than one internal system is involved in a risk zone, values of P_C and P_M are given by:

$$P_C = 1 - (1 - P_{C1}) \times (1 - P_{C2}) \times \ldots \times (1 - P_{Cn}) \quad (14)$$

$$P_M = 1 - (1 - P_{M1}) \times (1 - P_{M2}) \times \ldots \times (1 - P_{Mn}) \quad (15)$$

where P_{Cn} and P_{Mn} are parameters relevant to internal system n = 1, 2, 3…

If more than one value of any other parameter exists in a risk zone, the value of the parameter leading to the highest value of partial frequency of damage shall be assumed, with the exception made for P_C and P_M.

NOTE 1 An internal system is not necessarily connected directly to an external service. For example, it can be connected to a copper power line and to a data line connected via an isolation interface.

NOTE 2 A simpler approach is to use $P_C = P_{C1}$ and $P_M = P_{M1}$ where P_{C1} and P_{M1} refer to the worst cases.

9.4.2 Single-zoned structure

In this case, only one risk zone Z_S made up of the entire structure is defined. The frequency of damage F is the sum of partial frequencies of damage F_X in this risk zone.

Defining the structure as a single risk zone can lead to expensive protection measures because each measure shall extend to the entire structure.

9.4.3 Multi-zoned structure

In this case, the structure is divided into multiple risk zones Z_S. The frequency of damage F_{zone} for the risk zone is the sum of the partial frequencies of damage $F_{zone/X}$ relevant to all sources of damage.

Dividing a structure into risk zones allows the designer to take into account the characteristics of each part of the structure in the evaluation of the partial frequency of damage and to select the most suitable protection measures tailored risk zone by risk zone, reducing the overall cost of protection against lightning.

Annex A
(informative)

Assessment of annual number N of dangerous events

A.1 General

The average annual number N of dangerous events due to lightning flashes influencing a structure to be assessed depends on the lightning ground strike-point density of the region where the structure is located and on the structure's physical characteristics.

The lightning ground strike-point density N_{SG} is the number of lightning strike points per km^2 per year. In many areas of the world this value can be obtained from data provided by lightning location systems (LLS) complying with IEC 62858.

When N_{SG} values are not available directly, it is possible to account for flashes with multiple ground strike points. The values of lightning ground flash density N_G, can be multiplied by a factor k to estimate N_{SG} depending on many factors such as geographical location. This factor k should be obtained from the national LLS data provider.

$$N_{SG} = k\ N_G \tag{A.1}$$

where

N_{SG} is the lightning ground strike-point density (1 per km^2 per year).

NOTE 1 When the LLS data provider cannot provide this factor k or it does not exist (for example when a N_G map exists for a country), a factor 2 can be assumed.

In areas without ground-based lightning location systems, the recommended estimate of lightning ground strike-point density is

$$N_{SG} = 0{,}5\ N_T \tag{A.2}$$

where N_T is the total (ground CG + cloud IC) density of optically recorded flashes per km^2 per year, obtained through the NASA website http://lightning.nsstc.nasa.gov/data/data_lis-otd-climatology.html [7].

NOTE 2 In most areas of the world, an indication of lightning activity can be obtained from observations of lightning optical transients. Satellite-based sensors respond to all types of lightning with relatively uniform coverage. With sufficient averaging, optical transient density data provide better estimates of ground flash density than thunder observations, which have a wide range of relations between ground flash density and thunderstorm hours or thunderstorm days. There are also regional variations in the ratio of ground flashes (CG) to total flashes (CG + IC).

NOTE 3 IEC 62858 specificies how lightning data is obtained and presented.

Events that can be considered as dangerous to a structure being considered for protection are:

– flashes to the structure,
– flashes to ground near the structure,
– flashes to a line entering the structure, including flashes to another structure to which the

– flashes to ground near a line entering the structure.

NOTE 4 Annex A provides simplified methods to calculate the number N of dangerous events due to lightning flashes influencing a structure to be protected.

A.2 Assessment of the average annual number of dangerous events N_D due to flashes to a structure and N_{DJ} to an adjacent structure

A.2.1 Determination of the collection area A_D

A.2.1.1 General

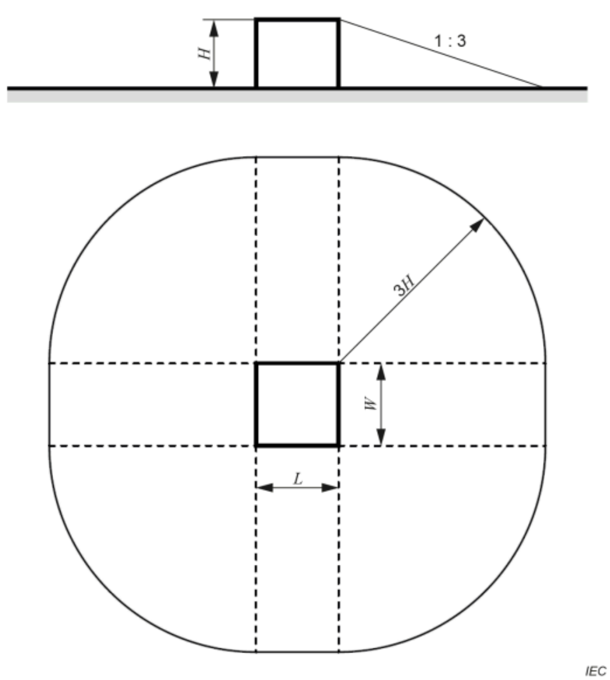
For isolated structures on flat ground, the equivalent collection area A_D is the area defined by the intersection between the ground surface and a straight line with 1/3 slope which passes from the upper parts of the structure (touching it there) and rotating around it. Determination of the value of A_D can be performed graphically or mathematically.

A.2.1.2 Rectangular structure

For an isolated rectangular structure with length L, width W, and height H on flat ground, the equivalent collection area is then equal to:

$$A_D = L \times W + 2 \times (3 \times H) \times (L + W) + \pi \times (3 \times H)^2 \quad \text{(A.3)}$$

where L, W and H are expressed in metres (see Figure A.1).



A.2.1.3 Complex-shaped structure

If the structure has a complex shape, such as elevated roof protrusions (see Figure A.2), a graphical method should be used to evaluate A_D (see Figure A.3).

An acceptable approximate value of the collection area is the greater value between the equivalent collection area A_{DMIN} evaluated with Equation (A.3) taking the minimum height H_{MIN} of the structure, and the collection area attributed to the elevated roof protrusion A_D'. A_D' can be calculated by:

$$A_D' = \pi \times (3 \times H_P)^2 \tag{A.4}$$

where H_P is the height of protrusion.

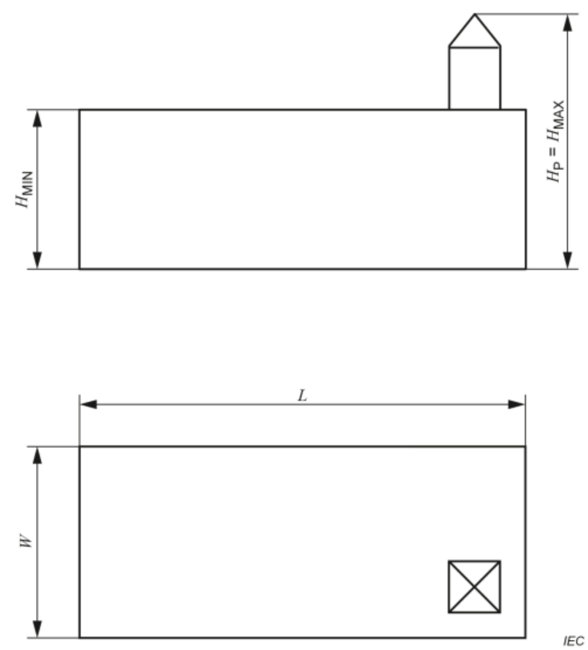


Figure A.2 – Complex-shaped structure

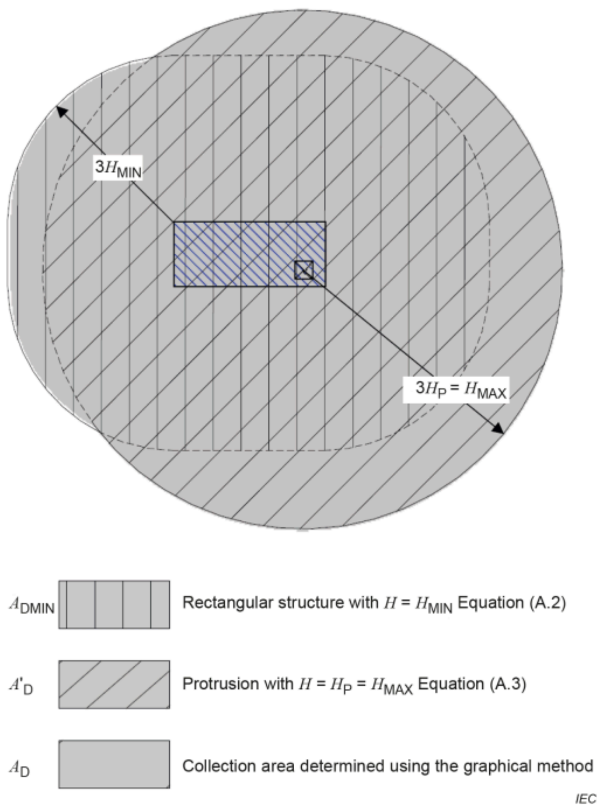


Figure A.3 – Different methods to determine the collection area for a given structure

A.2.2 Structure as a part of a building

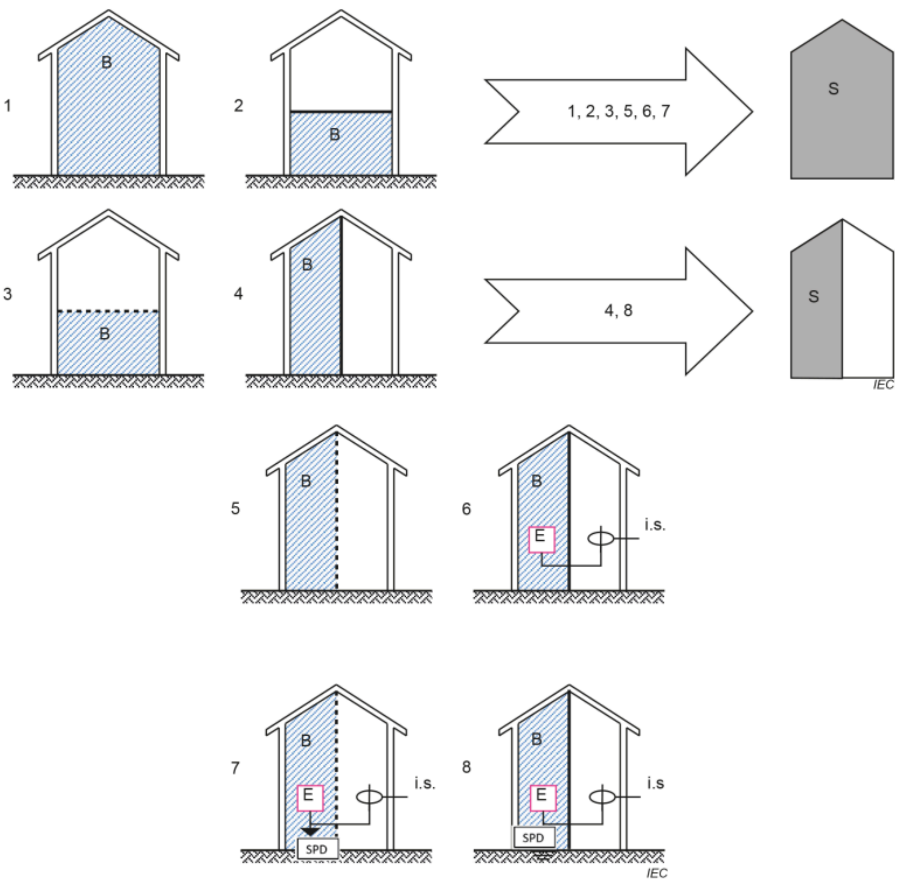
Where the structure S to be considered consists of only a part of a building B, the dimensions of structure S can be used in evaluation of A_D provided that the following conditions are fulfilled (see Figure A.4):

– the structure S is a separated vertical part of the building B as shown in Figure A.4;
– the building B does not have a risk of explosion;
– propagation of fire between the structure S and other parts of the building B is restricted e.g. by means of walls with resistance to fire of 120 min or by means of other equivalent protection measures.

NOTE Fire regulations can fix different values for the resistance to fire. Building regulations can fix wall resistance to fire.

– propagation of overvoltages along common lines, if any, is avoided by means of SPDs installed at the entrance point of such lines in the structure or by means of other equivalent protection measure.

Where these conditions are not fulfilled, the dimensions of the whole building B should be used.



Key

- B building or part of it for which protection is considered (evaluation of A_D is necessary)
- part of building for which protection is not considered (evaluation of A_D is not necessary)
- S structure to be considered for risk assessment (dimensions of S shall be used for evaluation of A_D)
- partitioning with resistance to fire ≥ 120 min
- partitioning with resistance to fire < 120 min
- E equipment
- i.s. internal system
- SPD SPD

Figure A.4 – Structure to be considered for evaluation of collection area A_D

A.2.3 Relative location of the structure

The relative location of the structure, compensating for surrounding structures or an exposed location, will be taken into account by a location factor C_D (see Table A.1).

A more precise evaluation of the surrounding objects' influence can be obtained considering the relative height of the structure with respect to the surrounding objects or the ground within a distance of 3 × H from the structure and assuming C_D = 1.

Table A.1 – Structure location factors C_D and C_{DJ}

Relative location	C_D or C_{DJ}
Structure surrounded by higher objects	0,25
Structure surrounded by objects of the same height or smaller	0,5
Isolated structure: no other objects in the vicinity	1
Isolated structure on hilltop or a knoll	2

NOTE 1 A more complete method based on 3D models can provide detailed results, considering the impact of surrounding buildings and environment.

NOTE 2 The usual way to determine coefficient C_D or C_{DJ} is to determine the influence of objects within a distance of 3H from the considered building (overlapping of collection areas).

NOTE 3 C_D is representative of an equivalent collection area of the structure; C_D depends on the height of the nearby structures, the width and in general the collection of the nearby structures. It is not a simple geometric calculation. However, to give an indication, C_D = 0,25 can be considered for example when the collection area of the physical structure itself and the ground within a distance of 3 × H is permanently covered by the collection area of surrounding objects to 75 %. C_D = 0,5 for example when the collection area of the physical structure itself and the ground within a distance of 3 × H is permanently covered by the collection area of surrounding objects to 50 %. C_D = 1 for example when the collection area of the physical structure itself and the ground within a distance of 3 × H is marginally covered by the collection area of surrounding objects.

A.2.4 Number of dangerous events N_D for the structure

N_D can be evaluated as the product:

$$N_D = N_{SG} \times A_D \times C_D \times 10^{-6} \tag{A.5}$$

where

N_{SG} is the lightning ground strike-point density per km^2 per year;

A_D is the equivalent collection area of the structure (m^2);

C_D is the location factor of the structure (see Table A.1).

NOTE In areas with isolated tall structures a more accurate evaluation of N_D can be advisable. Further information can be provided by national committees.

A.2.5 Number of dangerous events N_{DJ} for an adjacent structure

The average annual number of dangerous events due to flashes to a structure connected at the far end of a line, N_{DJ} can be evaluated as the product:

$$N_{DJ} = N_{SG} \times A_{DJ} \times C_{DJ} \times C_T \times 10^{-6} \quad \text{(A.6)}$$

where

N_{SG} is the lightning ground strike-point density per km² per year;

A_{DJ} is the equivalent collection area of the adjacent structure (m²);

C_{DJ} is the location factor of the adjacent structure (see Table A.1);

C_T is the line type factor (see Table A.3).

A.3 Assessment of the average annual number of dangerous events N_M due to flashes near a structure

N_M can be evaluated as the product:

$$N_M = (1/\,k) \times N_{SG} \times A_M \times 10^{-6} \quad \text{(A.7)}$$

where

N_{SG} is the lightning ground strike-point density per km² per year;

A_M is the equivalent collection area of flashes striking near the structure (m²).

NOTE 1 When N_{SG} is obtained directly by LLS, the factor k is provided by the LLS data provider. When not available, k = 2 can be assumed (see Clause A.1).

NOTE 2 In power systems the dangerous events N_M can be usually disregarded due to the use of concrete building with dense rebar mesh.

NOTE 3 Environmental factor C_E can also influence N_M, e.g. N_M can be multiplied by the environment coefficient C_E.

The equivalent collection area A_M extends to a line located at a conventional distance r_M from the perimeter of the structure:

$$A_M = 2 \times r_M \times (L + W) + \pi \times r_M{}^2 \quad \text{(A.8)}$$

where

r_M = 350/U_w (m);

U_w is the equipment impulse rated voltage in kV of the equipment having the lowest insulation level.

NOTE 4 Typical values for U_W can be found in Table B.11 and Table B.12.

NOTE 5 This Formula (A.8) is calculated considering a loop area of 50 m² considering its random position with

A.4 Assessment of the average annual number of dangerous events N_L due to flashes to a line

A line can consist of several sections. For each section of line, the value of N_L can be evaluated by:

$$N_L = N_{SG} \times A_L \times C_I \times C_E \times C_T \times 10^{-6} \quad \text{(A.9)}$$

where

N_L is the number of overvoltages of amplitude not lower than 1 kV (1/year) on the line section;

N_{SG} is the lightning ground strike-point density per km^2 per year;

A_L is the equivalent collection area of flashes striking the line (m^2);

C_I is the installation factor of the line (see Table A.2);

C_T is the line type factor (see Table A.3);

C_E is the environmental factor (see Table A.4);

with the collection area for flashes to a line:

$$A_L = 40 \times L_L \quad \text{(A.10)}$$

where

L_L is the length of the line section (m).

When information of the section lengths is not available, a maximum line length of 1 km for the sum of HV power lines and LV power lines and a maximum line length of 1 km for telecom lines can be assumed.

NOTE 1 More information on the equivalent collection areas A_L for telecommunication lines can be found in ITU-T Recommendation K.47 [8].

NOTE 2 A realistic maximum total length to be considered for power lines is generally 2 km.

Table A.2 – Line installation factor C_I

Routing	C_I
Aerial	1
Buried	0,3
Buried cables running entirely within a meshed earth termination (IEC 62305-4:2024, 5.2).	0,01

NOTE 3 The ground resistivity affects the collection area A_L of buried sections. In general, the larger the ground resistivity, the larger the equivalent collection area. The installation factor of Table A.2 is based on ρ = 400 Ωm. For ρ > 400 Ωm, the following equation for a buried section can be used $A_L = 0{,}6 \times \sqrt{\rho} \times L_L$.

NOTE 4 Different values can be assigned to the installation factor C_I after detailed investigation.

Table A.3 – Line type factor C_T

Installation	C_T
LV power, telecommunication or data line or HV power line with HV/LV auto-transformer	1
HV power (with HV/LV transformer with separated windings)	0,2

NOTE 5 Different values can be assigned to the line type factor C_T after detailed investigation. Lower values for C_T are possible.

Table A.4 – Environmental factor C_E

Environment	C_E
Rural	1
Suburban	0,5
Urban	0,1
Urban with buildings higher than 20 m.	0,01

NOTE 6 The values given for C_E reduce the number of dangerous events caused by sources S3 and S4 due to the protection of the surrounding structures.

NOTE 7 Different values can be assigned to the environmental factor C_E after detailed investigation.

A.5 Assessment of average annual number of dangerous events N_I due to flashes near a line

A line can consist of several sections. For each section of line, the value of N_I can be evaluated by

$$N_I = (1/k) \times N_{SG} \times A_I \times C_I \times C_E \times C_T \times 10^{-6} \qquad \text{(A.11)}$$

where

N_I is the number of overvoltages per year of amplitude higher than U_W on the line section;

N_{SG} is the lightning ground strike-point density per km^2 per year;

A_I is the equivalent collection area of flashes to ground near the line (m^2);

C_I is the installation factor (see Table A.2);

C_T is the line type factor (see Table A.3);

C_E is the environmental factor (see Table A.4).

NOTE 1 When N_{SG} is obtained directly by LLS, the factor k is provided by the LLS data provider. When not available, k = 2 can be assumed (see Clause A.1).

The equivalent collection area A_I for flashes near a line extends to a line located at a conventional distance r_I from the line:

$$A_I = 2 \times r_I \times L_L \tag{A.12}$$

where

L_L is the length of the line section (m);

r_I $= 2\,000/U_w^{1,8}$;

U_w is the equipment impulse rated voltage in kV.

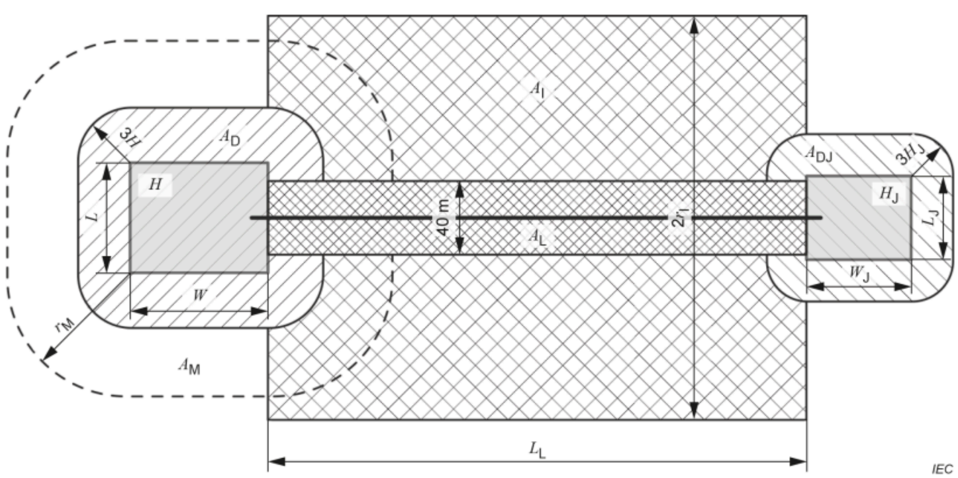
When information of the section lengths is not available, a maximum line length of 1 km for the sum of HV power lines and LV power lines and a maximum line length of 1 km for telecom lines can be assumed.

NOTE 2 A more precise evaluation of A_I can be found in Electra no. 161 [9] and no. 162 [10], 1995 for power lines and in ITU-T Recommendation K.46 [11] for telecommunication lines.

NOTE 3 A realistic maximum total length to be considered for power lines is generally 2 km.

A.6 Representation of the equivalent collection areas

Figure A.5 shows the relationship of the five collection areas, A_D, A_{DJ}, A_M, A_L and A_I, as specified in A.2.1.2, A.2.1.3, Clause A.3, Clause A.4 and Clause A.5 respectively. It should be noted that the areas are not drawn to scale for typical dimensions.



NOTE The figure represents the collection area for one specific lateral distance.

Figure A.5 – Equivalent collection areas A_D, A_{DJ}, A_M, A_L and A_I

Annex B
(informative)

Assessment of probability P_X of damage

B.1 General

The probabilities given in this Annex B are valid if protection measures conform to:

– IEC 62305-3 for protection measures to reduce injury to human beings and for protection measures to reduce physical damage;

– IEC 62305-4 for protection measures to reduce failure of internal systems.

Other values can be chosen, if justified.

Values of probabilities P_X less than 1 can be selected only if the measure or characteristic is valid for the entire structure or risk zone of the structure (Z_S) to be protected and for all relevant equipment.

Values of probabilities P_X should take into account probability P_{TWS} if the relevant protective provisions provided are activated by means of a thunderstorm warning system (TWS) complying with IEC 62793 where P_{TWS} is the probability with which a TWS does not detect a lightning-related event in the target area.

NOTE 1 P_{TWS} = maximum value between failure to warn ratio (FTWR) and 1 − POD$_x$ (probability that a lead time of x minutes is obtained). The FTWR and POD$_x$ will generally be obtained from the manufacturer's product data sheet or the service provider. P_{TWS} = 1 can be assumed if the manufacturer does not declare the value of FTWR or POD$_x$.

NOTE 2 For protection measures and reduction values by the use of TWS, refer to IEC 62305-1 and IEC 62793. If temporary preventive measures are not applicable or a TWS is not provided P_{TWS} = 1 can be assumed. If the warning given by the TWS does not provide time enough for taking those measures, P_{TWS} = 1 can be assumed.

The values of factors to be used for the assessment of probability P_X of damage should be fixed by the lightning protection designer. The values of factors in a structure given in this Annex B are typical values. Different values can be assigned after detailed investigation.

The probability P_X of protection measures to reduce failure of internal systems depends on the probability P_{SPD} of a coordinated SPD system. According to the selected lightning protection level (LPL) value, a coordinated SPD system shall:

– withstand the lightning current expected at its installation point;

– limit the overvoltage value at the equipment input to a value not greater than equipment rated impulse voltage (U_w).

The probability P_{SPD} relevant to the coordinated SPD system depends on:

– the probability P_Q that the value of the expected charge associated with the current flowing through the SPD at its point of installation exceeds the one tolerated by the SPD;

– the probability P_{Up} that the value of residual voltage at the SPD exceeds the required protection level U_{pr} to limit the overvoltage value at the equipment input to a value not greater than the equipment rated impulse voltage (U_w).

Then the probability P_{SPD} is given by:

$$P_{SPD} = 1 - (1 - P_Q)(1 - P_{Up}) \qquad \text{(B.1)}$$

The probability P_Q refers to positive and negative first strokes, whereas the probability P_{Up} refers to the subsequent stroke of negative flashes.

NOTE 3 Internal systems can include externally mounted equipment provided it is not open to a direct strike according to the chosen LPS class.

B.2 Probability P_{AT} that a flash to a structure will cause dangerous touch and step voltages

The values of probability P_{AT} that a damage due to touch and step voltages by a lightning flash to the structure appear, depend on the protection measures provided:

$$P_{AT} = P_{LPS} \times P_{am} \times r_t \times P_{TWS} \qquad \text{(B.2)}$$

where

P_{LPS} is the probability depending on the LPL of measures to protect the exposed areas of the structure against a direct flash. Values of P_{LPS} are given in Table B.3;

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

NOTE 1 The purpose of a warning message created by a TWS is to ensure prompt and complete evacuation of the exposed area. If this evacuation is not ensured or a TWS is not provided or if the manufacturer does not declare the FTWR, P_{TWS} = 1 is assumed (see also IEC 62305-1 and IEC 62793 for restrictions of application of a TWS).

P_{am} is the probability that a flash to a structure will cause damage due to touch and step voltages according to different protection measures. Values of P_{am} are given in Table B.1;

r_t is the reduction factor as a function of the type of surface of soil or floor. Values of r_t are given in Table B.2.

NOTE 2 Protection measures are effective in reducing P_{AT} only in structures protected by an LPS or structures with continuous metal or reinforced concrete framework acting as a natural LPS.

Table B.1 – Values of probability P_{am} that a flash to a structure will cause damage due to touch and step voltages according to different protection measures

Protection measure	P_{am}
No protection measures	1
Warning notice	10^{-1}
Electrical insulation (e.g. at least 3 mm cross-linked polyethylene) of exposed parts (e.g. down conductors)	10^{-2}
Effective soil equipotentialization by means of meshed earth termination system[a]	10^{-2}
Natural LPS, see Note 3	10^{-3}
Access restrictions	0
[a] Protection measure effective against step voltages only.	

If more than one provision has been taken, the value of P_{am} is the product of the corresponding values.

NOTE 3 P_{am} = 0,001 can be assumed when the structure:

- has an extensive metal framework (see IEC 62305-3:2024, 8.1 and 8.2);
- is made of reinforced concrete cast on site, with the reinforcing rods interconnected in accordance with IEC 62305-3 and verified according to the method described in IEC 62305-3:2024, Annex D.
- is provided with a meshed earth termination system and there is no accessible metal installation which can become a part of the path of the lightning current.

Table B.2 – Reduction factor r_t as a function of the type of surface of soil or floor

Type of surface[a]	Contact resistance[b] kΩ	r_t
Agricultural, concrete	≤ 1	10^{-2}
Marble, ceramic	1 – 10	10^{-3}
Gravel, moquette, carpets	10 – 100	10^{-4}
Asphalt, linoleum, wood	≥ 100	10^{-5}
NOTE Particular attention is taken when isolating soil covering layers are in wet conditions or covered with a water layer.		
[a] A layer of insulating material, e.g. asphalt, of 5 cm thickness generally reduces the hazard to a tolerable level. In these cases r_t = 0 can be assumed.		
[b] Contact resistance as per definition IEV 581-23-08. Values measured between a 400 cm² electrode compressed with a uniform force of 750 N and a point where voltage is not modified by current injection.		

B.3 Probability P_{AD} that a flash will cause damage to an exposed person on the structure

The values of probability P_{AD} that a flash will strike a person on the structure depend on the position of people in the exposed area, on the lightning protection level (LPL) of adopted measures to protect the exposed areas of the structure against the direct flash and on additional protection measures such that:

$$P_{AD} = P_{TWS} \times P_{am} \times P_O \times P_{LPS} \tag{B.3}$$

where

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

NOTE 1 The purpose of a warning message created by a TWS is to ensure prompt and complete evacuation of the exposed area. If this evacuation is not ensured or a TWS is not provided or if the manufacturer does not declare the FTWR, P_{TWS} = 1 is assumed (see also IEC 62305-1:2024, 7.1 for restrictions of application of a TWS).

NOTE 2 When a TWS is used, P_{am} can be ignored.

P_{am} is the probability that a flash to a structure will cause damage due to touch and step voltages according to different protection measures. Values of P_{am} are given in Table B.1;

P_O is the probability factor according to the position of a person in the exposed area, where P_O is assumed equal to 1 when the person is exposed (and equal to 0 when there is nobody);

P_{LPS} is the probability depending on the LPL of measures to protect the exposed areas of the structure against a direct flash. Values of P_{LPS} are given in Table B.3;

NOTE 3 P_{LPS} can be included in Equation (B.3) only when people are within the protected area of the LPS.

P_{am} is the probability that a flash to a structure will cause damage due to touch and step voltages.

Table B.3 – Values of probability P_{LPS} depending on the protection measures to protect the exposed areas of the structure against the direct flash and to reduce physical damage

Characteristics of structure	Class of LPS	P_{LPS}
Structure or exposed areas not protected	-	1
Structure or exposed areas protected by an LPS	IV	0,2
	III	0,1
	II	0,05
	I	0,02
Structure protected by an LPS I with a continuous metal or reinforced concrete framework acting as a natural down-conductor system		0,01
Structure protected by an LPS I with a metal roof and an air-termination system, possibly including natural components, with complete protection of any roof installations against direct lightning strikes and a continuous metal or reinforced concrete framework acting as a natural down-conductor system		0,001

NOTE 4 Values of P_{LPS} other than those given in Table B.3 are possible if based on a detailed investigation taking into account the requirements of sizing and interception criteria defined in IEC 62305-1.

NOTE 5 The characteristics of the LPS, including those of the SPD for lightning equipotential bonding, are reported in IEC 62305-3.

NOTE 6 The protection level of the LPS can be different for protection of the exposed areas of the structure against the direct flash or to reduce physical damage.

NOTE 7 For more information see IEC 62305-3:2024, 8.1 and 8.2.

B.4 Probability P_B that a flash to a structure will cause physical damage by fire or explosion

The probability P_B that a flash to a structure will cause physical damage by fire or explosion is given by:

$$P_B = P_S \times P_{LPS} \times r_f \times r_p \tag{B.4}$$

where

P_S is the probability that a flash to a structure will cause dangerous sparking. Values of P_S are given in Table B.4;

P_{LPS} is the probability depending on the protection measures to reduce physical damage. Values of P_{LPS} are given in Table B.3;

r_p is the reduction factor as a function of provisions taken to reduce the consequences of fire. Values of r_p are given in Table B.5;

r_f is the reduction factor as a function of risk of fire or explosion of structure. Values of r_f are given in Table B.6.

Table B.4 – Values of probability P_S that a flash to a structure will cause dangerous sparking

Type of structure	P_S
Wood and masonry	1
Electrically-continuous reinforced concrete or Interconnected metal framework	0,5

NOTE 1 If there is no LPS installed or if the LPS is not installed according to IEC 62305-3, Table B.4 gives the value for P_S. If an LPS is installed according to IEC 62305-3, P_S = 1 and the beneficial effect of the LPS is taken into account by P_{LPS}.

NOTE 2 If significant metal protruding parts not bonded to the structure framework are present, P_S = 1 can be adopted.

NOTE 3 When walls and roof are not of the same type, a larger value for P_S can be considered.

NOTE 4 For reinforcement, the value of 0,5 is only valid if reinforcement is sufficiently interconnected and connected to the earthing arrangement.

Table B.5 – Reduction factor r_p as a function of provisions taken to reduce the consequences of fire

Provisions	r_p
No provisions	1
One of the following provisions: extinguishers; fixed manually-operated extinguishing installations[a]; manual alarm installations; hydrants; fire compartments; escape routes	0,5
One of the following provisions: fixed automatically operated extinguishing installations; automatic alarm installations[b]	0,2
NOTE These provisions are only valid if they are available and operational at the time of a lightning event. If in doubt r_p = 1 is suggested. In some countries, it is not possible to use other values than r_p = 1 unless an LPS is provided.	
[a] Provisions are effective only if operated by persons trained for this purpose and able to do so.	
[b] Only if protected against overvoltages and other damages and if firefighters can arrive in less than 10 min.	

Provisions taken to reduce the consequences of fire as described in Table B.5 do not prevent fire occurrence due to lightning. If fire mitigation measures are used in lightning risk calculation (r_p different from 1), the user should be informed. If the user is not informed, r_p = 1 should be applied.

In zones with a risk of explosion, r_p = 1 for all cases unless provisions are taken to ensure that a fire cannot trigger an explosion inside the explosive area.

In zones with lithium-ion batteries r_p = 1 should be applied. Small volume of such batteries can be disregarded (e.g. a portable computer).

Table B.6 – Reduction factor r_f as a function of risk of fire or explosion of structure

Risk	Level of risk	r_f
Explosion	Zones 0, 20 and solid explosive	1
	Zones 1, 21	10^{-1}
	Zones 2, 22	10^{-3}
Fire	High	10^{-1}
	Ordinary	10^{-2}
	Low	10^{-3}
Explosion or fire	None	0
NOTE Examples of fire loads for different type of structures can be found in other documents, for example EN 1991-1-2 [12].		

NOTE 1 In the case of a structure with a possibility of explosion, the values for r_f are suggested values that are presented as worst case for the purpose of lightning protection calculation in the absence of input from a facility owner or other valid source. Since the probability of hazardous conditions and consequence of ignition can vary from site to site, the application of the definitions for Zones 1 and 21 and Zones 2 and 22 and other principles from the IEC 60079 and ISO/IEC 80079 series would allow values to be determined with input from the facility owners or other valid sources for the particular application. Examples of valid sources include applicable standards and codes for the application.

NOTE 2 Where different conditions are present the worst case is used.

NOTE 3 Structures with a high risk of fire can be assumed to be structures made of combustible materials or structures with roofs made of combustible materials or structures with a specific fire load larger than 800 MJ/m^2.

NOTE 4 Structures with an ordinary risk of fire can be assumed to be structures with a specific fire load between 800 MJ/m2 and 400 MJ/m^2.

NOTE 5 Structures with a low risk of fire can be assumed to be structures with a specific fire load less than 400 MJ/m^2, or structures containing only a small quantity of combustible material.

NOTE 6 Specific fire load is the ratio of the energy of the total quantity of the combustible material in a structure and the overall surface of the structure.

NOTE 7 For the purposes of this document, structures associated with hazardous areas or solid explosive materials are not assumed to be structures with a risk of explosion if any one of the following conditions is fulfilled:

- the time of presence of explosive substances is lower than 0,1 h/year.
- the volume of explosive atmosphere leads to a zone of negligible extent.
- the hazardous area cannot be hit directly by a flash and dangerous sparking in the hazardous area is avoided. This condition is fulfilled in the following cases:

  For hazardous areas enclosed within metallic shelters, when the shelter, as a natural air-termination system, acts safely without puncture or hot-spot problems, and internal systems inside the shelter, if any, are protected against overvoltages to avoid dangerous sparking.

  For hazardous areas in structures, when the hazardous area is within structures protected by an LPS or structures with continuous metal or reinforced concrete framework acting as a natural LPS, where bonding requirements of IEC 62305-3 are satisfied and internal systems in the area, if any, are protected against overvoltages to avoid dangerous sparking.

NOTE 8 The definitions and criteria for hazardous areas and a zone of negligible extent are found in IEC 60079-10-1 [3] and IEC 60079-10-2 [4].

B.5 Probability P_C that a flash to a structure will cause failure of internal systems

A coordinated SPD system is suitable as a protection measure to reduce P_C.

The probability P_C that a flash to a structure will cause a failure of internal systems is given by:

$$P_C = P_{SPD} \times C_{LD} \tag{B.5}$$

P_{SPD} depends on the coordinated SPD system conforming to IEC 62305-4 and on internal system characteristics. Values of P_{SPD} are reported in Table B.7 and Table B.8.

C_{LD} is a factor depending on shielding, grounding and isolation conditions of the line to which the internal system is connected. Values of C_{LD} are given in Table B.9.

NOTE 1 A coordinated SPD system is effective in reducing P_C only in structures protected by an LPS or structures with continuous metal or reinforced concrete framework acting as a natural LPS, where bonding requirements of IEC 62305-3 are satisfied, irrespective of the LPS class.

NOTE 2 If the roof is considered as a zone of the building, then the protection measures are defined as for the other zones. If protection against direct flashes is required, the equipment on the roof is protected by the LPS and the SPDs are designed according to source of damage S1 (both resistive and inductive coupling) in Table B.7 or Table B.8 as a simple approach.

Table B.7 – Typical values of P_{SPD} for SPDs on the low-voltage system, used to protect against sources of damage S1, S2, S3, S4

LPL	Direct and indirect flashes to the line				Flash near the structure		Flash to the structure		Flash to the structure	
	Source of damage S3[a]		Source of damage S4[a]		Source of damage S2[a]		Source of damage S1[a] (inductive coupling)		Source of damage S1[b] (resistive coupling)	
	kA 10/350 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 10/350 µs	P_{SPD}
No SPDs		1		1		1		1		1
III to IV	5	0,05	0,3	0,05	0,1	0,05	5	0,05	12,5	0,05
II	7,5	0,02	0,45	0,02	0,15	0,02	7,5	0,02	18,75	0,02
I	10	0,01	0,6	0,01	0,2	0,01	10	0,01	25	0,01
Better than LPL I			2,5[c d]	10^{-4}	2,5[c]	10^{-4}				
			3,75[c d]	5×10^{-5}	3,75[c]	5×10^{-5}				
			5[c d]	10^{-5}	5[c]	10^{-5}				

NOTE 1 The necessary LPL for the SPDs can be different from the LPL of the LPS.

NOTE 2 For shielded lines, the values of the currents can be halved.

[a] For information on values of current and specific conditions, refer to IEC 62305-1:2024, Table E.1.

[b] Current values refer to a single service line (n = 1) having three phase conductors + neutral (n' = 4); sharing factor k_e = 0,5; more detailed information is given in IEC 62305-1:2024, Clause E.2.

[c] SPD commonly used.

[d] Values for S4 in IEC 62305-1:2024, Table E.1 defined for LPL I to IV, are reported in this table in lines "better than LPL I".

Table B.8 – Typical values of P_{SPD} for SPDs on the telecommunications system used to protect against sources of damage S1, S2, S3, S4

LPL	Direct and indirect flashes to the line				Flash near the structure		Flash to the structure		Flash to the structure	
	Source of damage S3[a]		Source of damage S4[a]		Source of damage S2[a e]		Source of damage S1[a d] (inductive coupling)		Source of damage S1[b] (resistive coupling)	
	kA 10/350 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 10/350 µs	P_{SPD}
No SPDs		1		1		1		1		1
III to IV	1	0,05	0,3	0,05	0,1	0,05	5	0,05	1,25[f]	0,05
II	1,5	0,02	0,45	0,02	0,15	0,02	7,5	0,02	1,875[f]	0,02
I	2	0,01	0,6	0,01	0,2	0,01	10	0,01	2,5[f]	0,01
Better than LPL I			2,5[c]	10^{-4}	2,5[c]	10^{-4}				
			3,75[c]	5×10^{-5}	3,75[c]	5×10^{-5}				
			5[c]	10^{-5}	5[c]	10^{-5}				

NOTE 1 The necessary LPL for the SPDs can be different from the LPL of the LPS.

NOTE 2 Refer to ITU-T Recommendation K.67 [13] for more information.

NOTE 3 Values referred to overhead unshielded lines. For buried lines, the values of the currents can be halved. For shielded lines, the values of the currents can be halved.

[a] For information on values of current and specific conditions, refer to IEC 62305-1:2024, Table E.2.

[b] Detailed information is given in IEC 62305-1:2024, Clause E.2.

[c] SPD commonly used.

[d] Loop conductors routing and distance from the inducing current affect the values of expected surge overcurrents. Values in IEC 62305-1:2024, Table E.2 refer to short-circuited, unshielded loop conductors with different routing in large buildings (loop area in the order of 50 m^2, width = 0,5 m), 1 m apart from the structure wall, inside an unshielded structure (k_c = 1). For other loop and structure characteristics, values should be multiplied by factors K_{S1}, K_{S2}, K_{S3} (see Clause B.6).

[e] Loop conductors routing and distance from inducing current affect the values of expected surge overcurrents. Values in IEC 62305-1:2024, Table E.2 refer to short-circuited, unshielded loop conductors with different routing (loop area in the order of 50 m^2, width = 0,5 m), 350 m apart from the lightning stroke, inside an unshielded structure. For other loop and structure characteristics, values should be multiplied by factors K_{S1}, K_{S2}, K_{S3} (see Clause B.6).

[f] Detailed information is given in IEC 62305-1:2024, Clause E.2.

Values of probability P_{SPD} given in Table B.7 and in Table B.8 refer to the case of P_{Up} being negligible in comparison with P_Q and then $P_{SPD} = P_Q$. The values of P_{SPD} given in Table B.7 and in Table B.8 can be obtained by means of an SPD system consisting of two SPDs. For some applications, the installation of two SPDs may not be possible. In order to assess the efficiency of an SPD system it is necessary to compare the protection level U_p and the discharge current parameters I_{imp}.

Different values of probability P_{SPD} than those given in Table B.7 and in Table B.8 can be used if they are sufficient to reduce the risk R and the frequency of damage F below the tolerable values.

NOTE 3 The characteristics of the line upstream of the SPD system and of the internal circuit downstream of the SPD system have a strong influence on the value of the probability P_{SPD} that an apparatus, protected by an SPD system, is damaged. As the matter is complicated, when information on proper selection of an SPD system with negligible P_{Up} is not available, as a first approximation, the simplified rules given for general guidance in IEC 62305-4:2024, Annex C, can be used. In this case the values of P_{SPD} achieved are higher than those given in Table B.7 and in Table B.8.

NOTE 4 Additional information on the selection of an SPD system giving the required probability P_{SPD} can be provided after detailed investigation.

NOTE 5 Values given in Table B.7 and Table B.8 apply for common cases. Values of P_{SPD} based on a more detailed analysis can be determined based on Annex D.

Table B.9 – Values of factors C_{LD} and C_{LI} depending on shielding, grounding and isolation conditions

External line type	Connection at entrance	C_{LD}	C_{LI}
Aerial line unshielded	Undefined	1	1
Buried line unshielded	Undefined	1	1
Multi grounded neutral power line	None	1	0,2
Shielded buried line (power or telecom)	Shield not bonded to the same bonding bar as equipment	1	0,3
Shielded aerial line (power or telecom)	Shield not bonded to the same bonding bar as equipment	1	0,1
Shielded buried line (power or telecom)	Shield bonded to the same bonding bar as equipment	1	0
Shielded aerial line (power or telecom)	Shield bonded to the same bonding bar as equipment	1	0
Lightning protective cable or wiring in lightning protective cable-ducts, metallic conduit, or metallic tubes	Shield bonded to the same bonding bar as equipment	0	0
No external line or optical line	No connection to metallic external lines	0	0
Any type	Connection to an isolating interface according to IEC 62305-4[a]	0	0

[a] For this equipment, C_{LD} and C_{LI} values are given in this table according to the external line type and connection at entrance. C_{LD} = 0 only if the isolating interface is protected by an SPD or if it is demonstrated by tests that the isolating interface has the appropriate surge withstand. In other cases, C_{LD} = 1. See also Note 5.

NOTE 6 An isolating interface is a part of an internal system and its probability of failure can be evaluated according to its withstand voltage. An SPD protecting the isolating interface, if provided, protects even the downstream equipment when the internal system between the isolating interface and the equipment is shielded; when the internal system is unshielded and if the voltage induced in this loop, calculated according to the required LPL, is greater than the rated impulse voltage of the equipment, an additional SPD can be used to protect downstream equipment.

NOTE 7 In the evaluation of probability P_C, values of C_{LD} in Table B.9 refer to shielded internal systems. The value of C_{LD} of an unshielded internal system not connected to external lines or optical lines, or connected to external lines consisting of lightning protective cable or systems with wiring in lightning protective cable-ducts, metallic conduit, or metallic tubes, bonded to the same bonding bar as equipment, is equal to the probability for which the induced voltage U_I is not higher than the rated impulse voltage U_w of the internal system ($U_I \leq U_w$). For evaluation of induced

B.6 Probability P_M that a flash near a structure will cause failure of internal systems

A grid-like LPS, screening, routing precautions, increased withstand voltage, isolating interfaces and coordinated SPD systems are suitable as protection measures to reduce P_M.

NOTE 1 An external LPS even to LPL I will generally have no significant screening effect.

The probability P_M that a lightning flash near a structure will cause the failure of internal systems depends on the adopted SPMs (see IEC 62305-4).

When a coordinated SPD system meeting the requirements of IEC 62305-4 is not provided, the value of P_M is equal to the value of P_{MS}.

When a coordinated SPD system according to IEC 62305-4 is provided, the value of P_M is given by:

$$P_M = P_{SPD} \times P_{MS} \tag{B.6}$$

For internal systems with equipment not conforming to the resistibility or withstand voltage level given in the relevant product standards, P_M = 1 should be assumed.

P_{SPD} depends on the coordinated SPD system and on the loop area of the circuit of the SPD and the apparatus to be protected. Values of P_{SPD} are reported in Table B.7 and Table B.8.

NOTE 2 Because of very low values of expected charge flowing through the SPD compared to what a typical selected SPD can withstand, P_{SPD} is the probability that the value of residual voltage exceeds the required protection level relevant to the current flowing through the SPD (P_{Up}); such probability depends on the loop area A of the circuit of the SPD and apparatus and on the rated impulse voltage U_W of the apparatus to be protected. Simplified rules are given for general guidance in IEC 62305-4:2024, Annex C.

The values of P_{MS} are obtained from the product:

$$P_{MS} = (K_{S1} \times K_{S2} \times K_{S3})^2 \tag{B.7}$$

where

K_{S1} takes into account the screening effectiveness of the structure, LPS or other shields at boundary LPZ 0/1;

K_{S2} takes into account the screening effectiveness of shields internal to the structure at boundary LPZ X/Y (X > 0, Y > 1);

K_{S3} takes into account the characteristics of internal wiring (see Table B.10);

NOTE 3 In Equation (B.6), K_{S4} (which was in previous editions of this document related to the impulse withstand voltage of the system to be protected) is taken equal to 1, because the withstand voltage is already taken into account when calculating N_M.

NOTE 4 $K_{S3} = S/50$,

where

$S = w \times l$ is the loop area;

w (m) is the width of the internal circuit;

l (m) is the length of the internal circuit.

Inside an LPZ, at a safety distance from the boundary screen at least equal to the mesh width w_m, factors K_{S1} and K_{S2} for the LPS or spatial grid-like shields can be evaluated as:

$$K_{S1} = 0,12 \times w_{m1} \quad \text{(B.8)}$$

$$K_{S2} = 0,12 \times w_{m2} \quad \text{(B.9)}$$

where w_{m1} (m) and w_{m2} (m) are the mesh widths of grid-like spatial shields, or of mesh type LPS down conductors or the spacing between the structure metal columns, or the spacing between a reinforced concrete framework acting as a natural LPS.

For continuous metal electromagnetic shields with thicknesses not lower than 0,1 mm, $K_{S1} = K_{S2} = 10^{-4}$.

NOTE 5 Where a meshed bonding network is provided according to IEC 62305-4, values of K_{S1} and K_{S2} can be halved.

Where the induction loop is running closely to the LPZ boundary shield conductors at a distance from the shield shorter than the safety distance, the values of K_{S1} and K_{S2} will be higher. For instance, the values of K_{S1} and K_{S2} should be doubled where the distance to the shield ranges from 0,1 w_m to 0,2 w_m.

For a cascade of LPZs the resulting K_{S2} is the product of the relevant K_{S2} of each LPZ.

NOTE 6 The maximum value of K_{S1} and K_{S2} is limited to 1.

Table B.10 – Value of factor K_{S3} depending on internal wiring

Type of internal wiring	K_{S3} [a]
Unshielded cable – no routing precaution in order to avoid loops[b]	1
Unshielded cable – routing precaution in order to avoid large loops[c]	0,5
Unshielded cable – routing precaution in order to avoid large loops[d]	0,2
Unshielded cable – routing precaution in order to avoid loops[e]	0,01
Shielded cables and cables running in metal conduits[f]	0,000 1

[a] Data referred to circuits 100 m long. For shorter circuits the K_{S3} values can be proportionally reduced.

[b] Loop conductors with different routing (spacing between live conductors and PE ≥ 0,5 m) in large buildings (loop area in the order of 50 m^2).

[c] Loop conductors routed in the same conduit (spacing between live conductors and PE ≤ 0,25 m) or loop conductors with different routing in small buildings (loop area in the order of 25 m^2).

[d] Loop conductors routed in the same conduit (spacing between live conductors and PE ≤ 0,1 m) or loop conductors with different routing in small buildings (loop area in the order of 10 m^2).

[e] Loop conductors routed in the same cable (spacing between live conductors and PE of the order of 0,005 m) (loop area of the order of 0,5 m^2).

[f] Shields and the metal conduits bonded to an equipotential bonding bar at both ends and equipment is connected to the same bonding bar.

B.7 Probability P_U that a flash to a line will cause damage due to touch voltage

The values of probability P_U that a flash to a line will cause damage due to touch voltage inside the structure, depends on the characteristics of the line shield, the impulse withstand voltage of internal systems connected to the line, the protection measures like physical restrictions or warning notices and the isolating interfaces or SPD(s) provided for equipotential bonding at the entrance of the line according to IEC 62305-3.

NOTE 1 A coordinated SPD system according to IEC 62305-4 is not necessary to reduce P_U; in this case SPD(s) according to IEC 62305-3 are sufficient.

The value of P_U is given by:

$$P_U = P_{am} \times P_{EB} \times P_{LD} \times P_{TWS} \times C_{LD} \times r_t \qquad \text{(B.10)}$$

where

P_{am} depends on protection measures against touch voltages, such as physical restrictions or warning notices. Values of P_{am} are given in Table B.1;

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

NOTE 2 The purpose of a warning message created by a TWS is to ensure prompt and complete evacuation of the exposed area. If this evacuation is not ensured or a TWS is not provided or if the manufacturer does not declare the FTWR, P_{TWS} = 1 is assumed (see also IEC 62305-1:2024, 7.1 for restrictions of application of a TWS).

NOTE 3 Disconnection is an option that can be used in a case-by-case evaluation, taking care of voltage generated in absence of surge protection. Disconnection can be valid for surges coming from lines (either direct or induced).

P_{LD} is the probability of failure of internal systems due to a flash to the connected line depending on the line characteristics. Values of P_{LD} are given in Table B.11 and Table B.12;

NOTE 4 Values of P_{LD} can be calculated with the following equations:

$P_{LD} = P(I)$

$I = U_w/(4 \times R_s \times \sqrt{\rho} \times 10^{-3})$

where

I is the peak current of positive and negative first strokes (kA);

R_s is the resistance per unit length of the sheath (Ω/km);

ρ is the soil resistivity (Ω · m).

P_{EB} depends on the equipotential bonding conforming to IEC 62305-3. Values of P_{EB} are reported in Table B.13;

NOTE 5 $P_{EB} = P_Q$

C_{LD} is a factor depending on shielding, grounding and isolation conditions of the line. Values of C_{LD} are given in Table B.9;

r_t is the reduction factor as a function of the type of surface of soil or floor. Values of r_t are given in Table B.2.

NOTE 6 When SPD(s) according to IEC 62305-3 are provided for equipotential bonding at the entrance of the line, earthing and bonding according to IEC 62305-4 can improve protection.

Table B.11 – Values of the probability P_{LD} depending on the resistance R_S of the cable screen and the impulse withstand voltage U_W of the equipment

Routing, shielding and bonding conditions		Withstand voltage U_W in kV							
		0,35	0,5	1	1,5	2,5	4	6	12
		P_{LD}							
Aerial or buried line, unshielded or shielded whose shield is not bonded to the same bonding bar as the equipment		1	1	1	1	1	1	1	1
Shielded aerial or buried, with shield bonded to the same bonding bar as the equipment	5 Ω/km < R_S ≤ 20 Ω/km	1	1	1	1	0,95	0,9	0,8	0,4
	1 Ω/km < R_S ≤ 5 Ω/km	1	1	0,9	0,8	0,6	0,3	0,1	0,02
	R_S ≤ 1 Ω/km	1	0,85	0,6	0,4	0,2	0,04	0,02	0,005

Table B.12 – Values of the probability P_{LD} depending on the resistance R_S of the cable screen and the higher impulse withstand voltage U_W of the equipment

Routing, shielding and bonding conditions		Withstand voltage U_W in kV					
		16	20	40	60	75	95
		P_{LD}					
Aerial or buried line, unshielded or shielded whose shield is not bonded to the same bonding bar as the equipment		1	1	1	1	1	1
Shielded aerial or buried, with shield bonded to the same bonding bar as the equipment	5 Ω/km < R_S ≤ 20 Ω/km	0,3	0,15	0,03	0,01	0,007	0,005
	1 Ω/km < R_S ≤ 5 Ω/km	0,01	0,007	0,001 5	0,001	4×10^{-4}	2×10^{-4}
	R_S ≤ 1 Ω/km	0,002	0,001 5	4×10^{-4}	$1,5 \times 10^{-4}$	10^{-4}	$0,7 \times 10^{-4}$

NOTE 7 In suburban and urban areas, an LV power line uses typically unshielded buried cable whereas a telecommunication line uses a buried shielded cable (with a minimum of 20 conductors, a shield resistance of 5 Ω/km, a copper wire diameter of 0,6 mm). In rural areas, an LV power line uses an unshielded aerial cable whereas a telecommunication line uses an aerial unshielded cable (copper wire diameter: 1 mm). An HV buried power line uses typically a shielded cable with a shield resistance in the order of 1 Ω/km to 5 Ω/km. The information provided by this note can be improved after a more detailed investigation.

NOTE 8 Values lower than those reported in Table B.11 and Table B.12 can be assigned to probability P_{LD} where the shield of the line is bonded at both ends to the same earthing system.

Table B.13 – Typical values of probability P_{EB} relevant to protection level LPL for which the SPD is designed to protect against source of damage S3

LPL	Power lines kA 10/350 µs	Telecommunication lines kA 10/350 µs	P_{EB}
No SPDs			1
III to IV	5	1	0,05
II	7,5	1,5	0,02
I	10	2	0,01
NOTE For information on values of current and specific conditions, refer to IEC 62305-1:2024, Table E.1 and Table E.2.			

NOTE 9 Values of P_{EB} lower than in Table B.13 are possible if the values of I_{imp} and I_n for which SPDs are designed, are higher than those required for LPL I.

B.8 Probability P_V that a flash to a line will cause physical damage by fire or explosion

The values of probability P_V that a flash to a line entering the structure will cause physical damage by fire or explosion, depend on the characteristics of the line shield, the impulse withstand voltage of internal systems connected to the line and the isolating interfaces or the SPDs provided for equipotential bonding at the entrance of the line according to IEC 62305-3.

NOTE 1 A coordinated SPD system according to IEC 62305-4 is not necessary to reduce P_V; in this case, SPDs according to IEC 62305-3 are sufficient.

The value of P_V is given by:

$$P_V = P_{EB} \times P_{LD} \times P_{TWS} \times C_{LD} \times r_f \times r_p \tag{B.11}$$

where

P_{LD} is the probability of failure of internal systems due to a flash to the connected line depending on the line characteristics. Values of P_{LD} are given in Table B.11 and Table B.12;

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

NOTE 2 The purpose of a warning message created by a TWS is to ensure prompt and complete evacuation of the exposed area. If this evacuation is not ensured or a TWS is not provided or if the manufacturer does not declare the FTWR, P_{TWS} = 1 is assumed (see also IEC 62305-1:2024, 7.1 for restrictions of application of a TWS).

NOTE 3 Disconnection is an option that can be used in a case-by-case evaluation, taking care of voltage generated in absence of surge protection. Disconnection can be valid for surges coming from lines (either direct or induced). See IEC 62305-1 for more details.

P_{EB} depends on the equipotential bonding conforming to IEC 62305-3; values of P_{EB} are reported in Table B.13;

C_{LD} is a factor depending on shielding, grounding and isolation conditions of the line. Values of C_{LD} are given in Table B.9;

r_p is the reduction factor as a function of provisions taken to reduce the consequences of fire. Values of r_p are given in Table B.5;

r_f is the reduction factor as a function of risk of fire or explosion of structure. Values of r_f are given in Table B.6.

NOTE 4 When a direct strike occurs on an external buried service it can damage the service (mechanical damage, fire, etc.) or create punctures on many places along the cable leading to long term degradation (corrosion for example). These damages are outside the scope of this document that is considering only the influence of the services to the studied structure.

B.9 Probability P_W that a flash to a line will cause failure of internal systems

The values of probability P_W that a flash to a line entering the structure will cause a failure of internal systems depend on the characteristics of line shielding, the impulse withstand voltage of internal systems connected to the line and the isolating interfaces or the coordinated SPD system installed.

The value of P_W is given by:

$$P_W = P_{SPD} \times P_{TWS} \times P_{LD} \times C_{LD} \tag{B.12}$$

where

P_{SPD} depends on the coordinated SPD system. Values of P_{SPD} are reported in Table B.7 and Table B.8;

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

NOTE The purpose of a warning message created by a TWS is to ensure prompt and complete evacuation of the exposed area. If this evacuation is not ensured or a TWS is not provided or if the manufacturer does not declare the FTWR, P_{TWS} = 1 is assumed (see also IEC 62305-1:2024, 7.1 for restrictions of application of a TWS).

P_{LD} is the probability of failure of internal systems due to a flash to the connected line depending on the line characteristics. Values of P_{LD} are given in Table B.11 and Table B.12;

C_{LD} is a factor depending on shielding, grounding and isolation conditions of the line. Values of C_{LD} are given in Table B.9.

B.10 Probability P_Z that a lightning flash near an incoming line will cause failure of internal systems

The values of probability P_Z that a lightning flash near a line entering the structure will cause a failure of internal systems depend on the characteristics of the line shield and the isolating interfaces or the coordinated SPD system provided.

The value of P_Z is given by:

$$P_Z = P_{SPD} \times P_{TWS} \times C_{LI} \quad \text{(B.13)}$$

where

P_{SPD} depends on the coordinated SPD system. Values of P_{SPD} are reported in Table B.7 and in Table B.8;

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

NOTE If a TWS creates a warning message, it is considered effective only if immediate and complete disconnection of the external distribution lines is ensured. If this disconnection is not ensured or a TWS is not provided P_{TWS} = 1 can be assumed.

C_{LI} is a factor depending on shielding, grounding and isolation conditions of the line. Values of C_{LI} are given in Table B.9.

B.11 Probability P_P that a person will be in a dangerous place

The probability P_P that a person will be in a dangerous place depends on the time t_z in hours per year for which the persons are present in the dangerous place:

$$P_P = t_z / 8\,760 \quad \text{(B.14)}$$

NOTE 1 Where the value of t_z is not known, the ratio t_z/8 760 = 1.

NOTE 2 In cases where a TWS allows a temporary evacuation of an area, t_z is multiplied by P_{TWS}.

B.12 Probability P_e that an equipment will be exposed to a damaging event

The probability P_e that an undamaged equipment is exposed to a damaging event depends on the time t_e in hours per year of exposure of the equipment to the damaging event.

$$P_e = t_e / 8\,760 \tag{B.15}$$

NOTE 1 Where the value of t_e is not known, the ratio t_e/8 760 = 1.

NOTE 2 In case of an explosive zone P_e can be calculated as $P_e = (t_e / 8\,760) \times r_f$ (r_f being related to the maximum presence of explosive atmosphere time divided by 8 760) when calculating risk components. This does not apply for the calculation of frequency of damage where only P_e is used.

Annex C
(informative)

Assessment of loss L_X

C.1 General

L_X represents the mean extent of loss due to a dangerous event, expressed in a relative way related to the maximum extent of loss in the considered risk zone of the structure to be protected.

The values of L_X should be selected on the basis of the type of structure according to its function or contents, or both, the public impact of loss of structure (e.g. costs of emergency measures to limit the damage, the costs resulting from loss of the structure and production, the costs of reconstruction and in the general costs that the public has to bear).

The values of loss L_X should be evaluated and fixed by the lightning protection designer (or the owner of the structure). The mean values of loss L_X in a structure given in this Annex C are typical values. Different values can be assigned after detailed investigation.

NOTE 1 When the damage to a structure due to lightning can also involve surrounding structures or the environment (e.g. fire propagation, explosion, chemical or radioactive emissions), a more detailed evaluation of L_X taking into account this additional loss can be performed. See Annex E.

NOTE 2 It is rare that loss of human life is not considered at all because most of the structures are staffed (at least for some periods of time, for example a maintenance team or security personnel). Other structures have almost permanent presence of human life such as national heritage or office building having employees and visitors.

It is emphasized that the overall risk for a given structure or application most often consists of a combination of risk components. However, to only calculate the risk of loss of human life (including permanent injury), then one or both of the following mean relative losses can be fixed equal to 0:

L_{F2} is the typical mean ratio of physical damage by fire or explosion;

L_{O2} is the typical mean ratio of physical damage by failure of internal systems.

In the same way, to only calculate the risk assuming there is no risk of loss of human life (including permanent injury) it is then possible to fix one or more of the following mean relative losses equal to 0:

L_T is the typical mean ratio of persons injured by touch and step voltages;

L_D is the typical mean ratio of persons injured by direct lightning stroke;

L_{F1} is the typical mean ratio of persons injured by fire or explosion;

L_{O1} is the typical mean ratio of persons injured by failure of internal systems;

And other parameters are calculated taking into account the application.

C.2 Mean relative loss per dangerous event

The loss L_X refers to the mean relative extent of a specified type of loss for one dangerous event caused by a lightning flash, considering both its extent and effects.

The loss value L_X varies with the cause of damage (D_{1D}, D_{1T}, D_2 and D_3).

The loss L_X should be determined for each risk zone of the structure into which it is divided or the structure as a whole.

The loss value L_X for each risk zone or the structure can be determined according to Table C.1

Table C.1 – Loss values for each zone

Typical loss
$L_{AT} = L_{UT} = L_T$
$L_{AD} = L_D$
$L_{B1} = L_{V1} = L_{F1}$
$L_{B2} = L_{V2} = L_{F2}$
$L_{C1} = L_{M1} = L_{W1} = L_{Z1} = L_{O1}$
$L_{C2} = L_{M2} = L_{W2} = L_{Z2} = L_{O2}$

where

L_T is the typical mean ratio of persons injured by touch and step voltages related to the total number of persons in the risk zone or the structure, due to one dangerous event (see Table C.2);

L_D is the typical mean ratio of persons injured by direct lightning stroke related to the total number of persons exposed in the risk zone or the structure, due to one dangerous event (see Table C.2);

L_{F1} is the typical mean ratio of persons injured by fire or explosion related to the total number of persons in the risk zone or the structure, due to one dangerous event (see Table C.2);

L_{F2} is the typical mean ratio of physical damage by fire or explosion related to the maximum extent of damage in the risk zone or the structure, due to one dangerous event (see Table C.2);

L_{O1} is the typical mean ratio of persons injured by failure of internal systems related to the total number of persons in the risk zone or the structure, due to one dangerous event (see Table C.2);

L_{O2} is the typical mean ratio of physical damage by failure of internal systems related to the maximum extent of damage in the risk zone or the structure, due to one dangerous event (see Table C.2).

NOTE 1 The typical mean value of the loss can be seen as the average value of the loss due to a dangerous event causing damages.

NOTE 2 Regarding L_{F1} or L_{O1} and L_{F2} or L_{O2} the levels of loss can be different for people and structure and this means that for example for a hospital, L_{F1} can be selected in the first row and L_{F2} in the second row of Table C.2 and vice versa for a museum.

NOTE 3 It is possible to use $L_{F1} = L_{F2}$ by selecting the highest value of both proposed values in Table C.2.

NOTE 4 L_T, L_D, L_{F1}, L_{O1} refer to human beings and L_{F2} and L_{O2} refer to structures and internal systems.

Table C.2 – Typical mean values of L_T, L_D, L_{F1}, L_{F2}, L_{O1} and L_{O2}

Type of structures or risk zones	L_T	L_D	L_{F1}	L_{F2}	L_{O1}	L_{O2}
Very high loss or highly critical structures or risk zones[a]	10^{-2}	$10^{-2} - 10^{-1}$	$10^{-2} - 2 \times 10^{-1}$	$10^{-2} - 2 \times 10^{-1}$	$10^{-3} - 10^{-2}$	$10^{-3} - 10^{-2}$
High loss or critical structures or risk zones[b]			$10^{-2} - 10^{-1}$	$10^{-2} - 10^{-1}$	$10^{-4} - 10^{-3}$	$10^{-4} - 10^{-3}$
Normal loss structures or risk zones[c]			$5 \times 10^{-3} - 5 \times 10^{-2}$	$5 \times 10^{-3} - 5 \times 10^{-2}$	$10^{-5} - 5 \times 10^{-4}$ [e]	$10^{-5} - 5 \times 10^{-4}$ [e]
Low-loss structures or risk zones[d]			$2 \times 10^{-3} - 2 \times 10^{-2}$	$2 \times 10^{-3} - 2 \times 10^{-2}$	$10^{-5} - 10^{-4}$ [e]	$10^{-5} - 10^{-4}$ [e]

[a] Such as structures or risk zones with a risk of explosion, structures or risk zones with life-saving electrical equipment or other structures when failure of internal systems involve injury to human beings or danger to the environment (e.g. operating rooms and intensive care units in hospitals).

[b] Such as structures or risk zones related to people with reduced mobility (e.g. rooms block in hospitals, prisons), structures or risk zones with essential equipment for carrying out processes (e.g. control room in industrial structures, power station, telecommunication centre), structures or risk zones with cultural heritage (e.g. museum).

[c] Such as structures open to the public (e.g. churches, hotels, schools, offices, civic building open to public, public entertainment, supermarkets).

[d] Such as buildings in private ownership (e.g. apartment house, farmhouse).

[e] This is only applicable when risk of explosion or when failure of internal systems involve injury to human beings or danger to the environment (e.g. equipment failure by a surge leading to release of polluted water to the river or when an equipment fire created by a surge can propagate to the structure when there are PV systems or DC voltages). In general structure or risk zone with such a risk are classified very high loss or high loss.

A more detailed evaluation can be necessary for the values for loss (L_{F1}, L_{F2}, L_{O1}, L_{O2}). The highest values for losses given in Table C.2 are recommended as default values. Other values can be used based on a specific study or experience especially if lower values than the proposed minimum values given in Table C.2 are used.

When the damage to a structure due to lightning involves surrounding structures or the environment (e.g. explosion, chemical or radioactive emissions), additional loss L_E should be taken into account to evaluate the total loss (L_{BT} and L_{VT}).

$$L_{BT} = L_B + L_E \tag{C.1}$$

$$L_{VT} = L_V + L_E \tag{C.2}$$

where L_E is the typical mean ratio of loss outside the structure related to the maximum extent of loss in the zone, due to one dangerous event.

NOTE 5 L_E can be evaluated using Annex E.

NOTE 6 Environmental influences can also be considered, if they are treated as a separate zone.

Annex D
(informative)

P_{SPD} evaluation

D.1 General

Values given in Table B.7 and Table B.8 apply for common cases. Values of P_{SPD} based on a more detailed analysis can be determined based on this Annex D.

This Annex D shows how the probability factor P_{SPD} of a coordinated SPD system can be determined. It is intended for specific applications when P_{SPD} values other than those given in Table B.7 and Table B.8 are used.

The evaluation of the P_{SPD} values against the different sources of damage (i.e. S1, S2, S3 and S4) is done through graphics, obtained by a calculation tool taking into account the propagation effect in the circuit between the SPD and the equipment to be protected, the induced voltage in this circuit and the voltage drop in the SPD connecting leads.

The graphics refer to typical installations and the defined rated impulse voltage of the equipment, i.e. 2,5 kV for power port and 1,5 kV for signal port of an equipment. It provides a guidance on how to obtain P_{SPD} for other cases using a similar method.

The probability P_X of protection measures to reduce the failure of internal systems depends on the probability P_{SPD} of a coordinated SPD system.

Failure of an equipment protected by an SPD system can occur either if:

a) the charge associated to the current I_{SPD} flowing through the SPD exceeds the value tolerated by the SPD or
b) the protection voltage U_p exceeds the required protection level U_{pr} of the SPD to limit the overvoltage value at the equipment input to a value not greater than the equipment impulse rated voltage (U_w).

The probability that an overvoltage will not damage an equipment protected by a coordinated SPD system is the probability that both conditions (a) and (b) will not occur.

Being:

– P_Q: probability associated with the source of damage causing the current described in condition (a);
– P_{Up}: probability associated with the source of damage causing the condition (b).

Then the probability P_{SPD} is given by:

$$P_{SPD} = 1 - (1 - P_Q) \times (1 - P_{Up}) \quad \text{(D.1)}$$

The probability P_{SPD} can be simplified as follows when referring the probability P_Q to positive and negative first strokes and the probability P_{Up} to the subsequent strokes of negative flashes (worst case) and when P_Q and P_{Up} are much less than 1:

$$P_{SPD} = P_Q + 0{,}9 \times P_{Up} \quad \text{(D.2)}$$

D.2 P_Q values

D.2.1 Probability values of both the negative and positive first strokes

The probability values of the charge can be calculated using the log-normal distributions of the charge of both negative first short (P_{Q-}, mean m = 4,69 and dispersion σ = 0,383) and positive first short (P_{Q+}, mean m = 17,3, dispersion σ = 0,57), given in IEC 62305-1:2024, Annex A, and combining the probabilities associated with a given charge value considering that 90 % of flashes are negative and 10 % positive. This (P_Q) calculation is reported in Figure D.1.

D.2.2 Source of damage S1

According to IEC 62305-1:2024, Annex E, the charge of the source of damage S1 causing the impulse current I_{imp} in the SPD can be calculated as follows:

$$Q = I_{imp} \times n \times n' / k_e \quad \text{(D.3)}$$

where

k_e = $n' \times R_s / (n' \times R_s + R_c)$;

n is the number of services entering the structure;

n' is the number of conductors of the considered service;

R_s is the shield resistance per unit length of the shielded service;

R_c is the conductor resistance per unit length of the service.

k_e = 1 for unshielded conductors.

The value of the charge given by Equation (D.3) is used for reading, in Figure D.1, the probability P_Q of the impulse current I_{imp} of the SPD.

EXAMPLE n = 2 services and n' = 4 unshielded conductors, I_{imp} = 10 kA, Equation (D.3) gives Q = 80 C and P_Q = 0,012 can be estimated in Figure D.1, whereas when n = 1, for the same 10 kA current, Equation (D.3) gives Q = 40 C and P_Q = 0,033 can be estimated in Figure D.1.

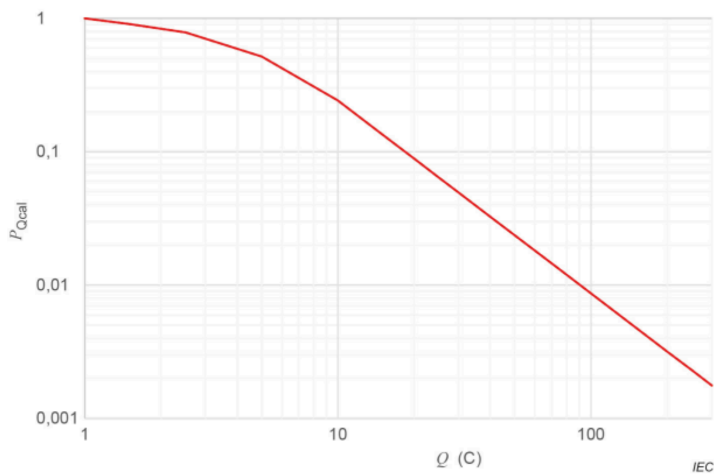


Figure D.1 – Charge probability of both negative and positive first strokes

D.2.3 Source of damage S3

According to IEC 62305-1:2024, Annex E, the charge of the source of damage S3 causing the impulse current I_{imp} in the SPD can be calculated as follows:

$$Q = 2{,}5 \times n' \times I_{imp} / k_e \tag{D.4}$$

The value of the charge given by Equation (D.4) is used for reading, in Figure D.1, the probability P_Q of the impulse current I_{imp} of the SPD.

EXAMPLE 1 n' = 2 unshielded conductors. For a power line when I_{imp} = 10 kA, Equation (D.4) gives Q = 50 C and then Figure D.1 gives P_{Q1} = 0,024. For a telecommunication line when I_{imp} = 2,5 kA, Equation (D.4) gives Q = 12,5 C and then Figure D.1 gives P_Q = 0,175.

For the specific case where a 2-conductor telecommunication line (one pair) it is usual (called hereafter "traditional telecommunication line") that the length (l_1) of the 2 conductors' section that enters the structure is about 10 % of the total length (typically about 4 km to 5 km of total length), where the other sections are composed by many pairs, e.g. some hundred pairs. In this case, the probability P_Q value can be specifically evaluated referring to the two conductors' section as follows:

$$P_Q = 0{,}1 \times P_{Q1} \tag{D.5}$$

where P_{Q1} is the probability of the charge given by Equation (D.4).

EXAMPLE 2 n' = 2 unshielded conductors. For a traditional telecommunication line, when I_{imp} = 1 kA, Equation (D.4) gives Q = 5 C and Figure D.1 gives P_{Q1} = 0,52 and then it is possible to use Equation (D.5) that gives P_Q = 0,052.

D.2.4 Sources of damage S2 and S4

According to the induced current values due to source of damage S2 or S4 given in Table B.7 and Table B.8 or in IE 62305-1:2024, Table E.2 and Table E.3, considering that the SPDs typically used have a nominal discharge current values I_n = 5 kA, the probability P_{QM} and P_{QZ} values are about 10^{-4} to 10^{-5} (almost negligible).

D.3 SPD protection level

D.3.1 General

For the purpose of this document, voltage switching and voltage limiting SPDs are defined as follows:

– voltage switching SPD: SPD that has a high impedance when no surge is present, but can have a sudden change in impedance to a low value in response to a voltage surge;
– voltage limiting SPD: SPD that has a high impedance when no surge is present, but will reduce it continuously with increased surge current and voltage.

D.3.2 Source of damage S1

D.3.2.1 One voltage limiting SPD

P_{Up} value is obtained for a current of 1 kA (due to the fact that P_{Up} relates to subsequent strokes) and the residual voltage at 1 kA is called U_p' hereafter.

NOTE 1 This value can be obtained from the SPD datasheet or, if not available, a common approximation is to take the residual voltage at 5 kA and reduce it by 200 V.

The P_{Up} values as a function of the residual voltage at 1 kA (U_p') are reported in Figure D.2 for different k_{1i} parameter values, when U_w = 2,5 kV, l_c = 0,5 m, $n \times n' \geq 8$ and $k_r > 1$.

where

k_{1i} =	$w \times k_c \times l_{eq} / d$;
l_{eq} =	$l_v + k_o \times l_o$ [m] (see IEC 62305-4:2024, Annex H);
l_v and l_o	are the lengths (m) of the induction loop between the SPD and the equipment parallel and orthogonal to the down conductors respectively;
l_o' =	$k_o \times l_o = [l_o \times w \times \ln(d + l_o) / \mathrm{d}]/[l_o \times \ln(d + w) / d]$ [m];
w	is the width (m) of the internal system;
k_c	is the current sharing between down conductors;
d	is the distance (m) of the induction loop from the nearest down conductor;
k_r	is the reflection coefficient;
k_0	is the ratio between the induced voltage in a loop orthogonal and parallel to the down conductor.

NOTE 2 According to Table B.10, a shielded cable can be represented by w = 0,000 05 m.

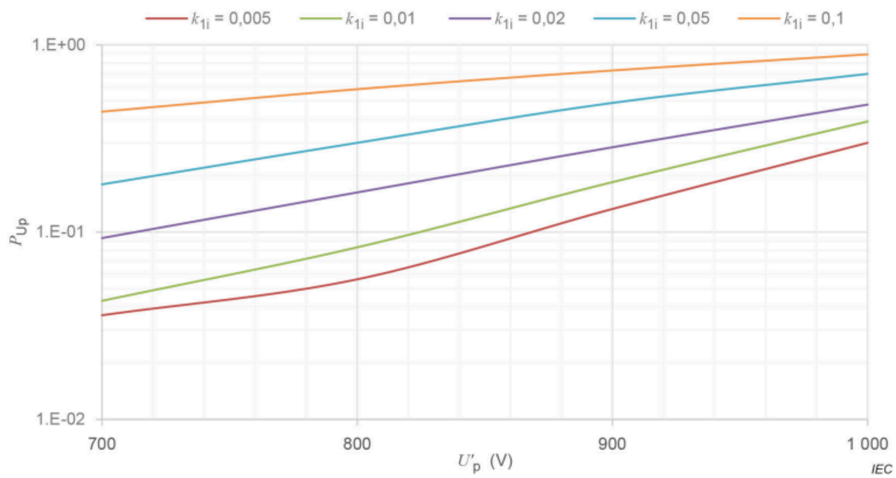


Figure D.2 – Probability P_{Up} as a function of the SPD residual voltage U_p' at 1 kA

EXAMPLE n = 2, n' = 4, w = 0,005 m, k_c = 0,44, d = 1 m, l_v = 6 m, l_O = 44 m, l_c = 0,5 m, U_w = 2,5 kV. In this case, l_o' = 3,8 m, l_{eq} = 9.8 m, k_{1i} = 0,02, selecting a voltage limiting SPD with U_p' = 900 V, Figure D.2 indicates P_{Up} ≈ 0,3.

D.3.2.2 One voltage switching SPD

The voltage switching SPDs are typically used on telecommunication lines at the entrance of the structure and typical protection levels of gas discharge tubes (GDT) are 700 V or 550 V.

Figure D.3 shows the P_{Up} values as a function of different k_{1i} parameter values for the two typical U_p values of GDTs, i.e. 700 V and 550 V, when U_w = 1,5 kV, l_c = 0,5 m, k_r > 1, n' ≥ 20 conductors.

NOTE U_p values refer to 1 kV/µs (see IEC 61643-21).

EXAMPLE n = 2, n' = 20, w = 0,1 m, k_c = 0,1, d = 2 m, l_v = 5 m, l_o = 21 m, l_c = 0,5 m, U_w = 1,5 kV. In this case, l_{eq} = 10 m, k_{1i} = 0,05, and selecting a voltage switching SPD with U_p = 550 V, Figure D.3 indicates P_{Up} ≈ 0,3.

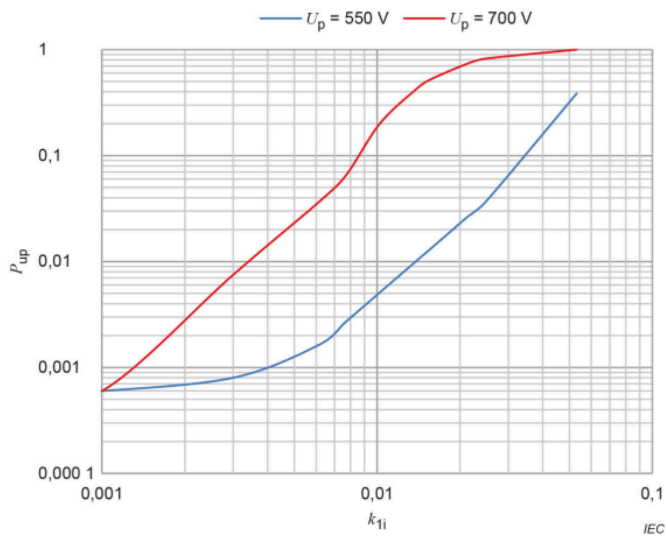


Figure D.3 – Probability P_{Up} as a function of k_{1i}

D.3.2.3 Combination of voltage limiting SPD and voltage switching SPD

When power is distributed according to the TT system, an SPD tested according to Class I tests can be installed upstream of the RCD. But in this case, protection against direct contact requires the installation of a voltage switching SPD between neutral and PE conductors (N-PE) in addition to voltage limiting SPDs between phase(s) and neutral conductors. In this case, it is possible to assume that the P_{Up} value is the greater value between that related to limiting or voltage switching SPDs.

Referring to typical installations where U_W = 2,5 kV and U_p = 1,5 kV of the voltage switching SPD, protection with one SPD can be achieved only when k_r = 1, i.e. when the distance of the SPD from the equipment to be protected is less than 10 m and damage to the equipment does not cause danger to persons. In this case, the P_{Up} value is that related to the voltage limiting SPD; the P_{Up} values for a typical installation are reported in Table D.1 as a function of the protection level at 1 kA of the voltage limiting SPD.

Table D.1 – P_{Up} values of the voltage limiting SPD for combination between a voltage limiting and a voltage switching SPD

n	n'	w m	d m	L_v m	L_o m	L_a m	k_c	k_r	U_p' kV	P_{Up}
2	4	0,005	1	2	8	10	0,44	1	0,8	0,005
									1	0,007
									1,2	0,009
When w = 0,1 m, P_{Up} values should be multiplied by a factor 60.										

When k_r > 1, a second SPD voltage limiting SPD shall be installed for protecting the equipment power port.

D.3.2.4 Two voltage limiting SPDs

When the necessary P_{SPD} cannot be achieved by only one SPD at the entrance of the service into the structure, a second voltage limiting SPD (SPD2), which can withstand a charge coordinated with the charge of the first SPD, should be installed.

The P_{SPD} of this coordinated SPD system is obtained adding the P_Q of the first SPD and the P_{Up} of the second SPD according to Equation (D.2).

These P_{Up} values as a function of the protection level at 1 kA (U_p') of SPD2 are reported in Figure D.4 for different k_{1i} parameter values, when U_w = 2,5 kV, l_c = 0,5 m, $n \times n' \geq 8$ and k_r > 1.

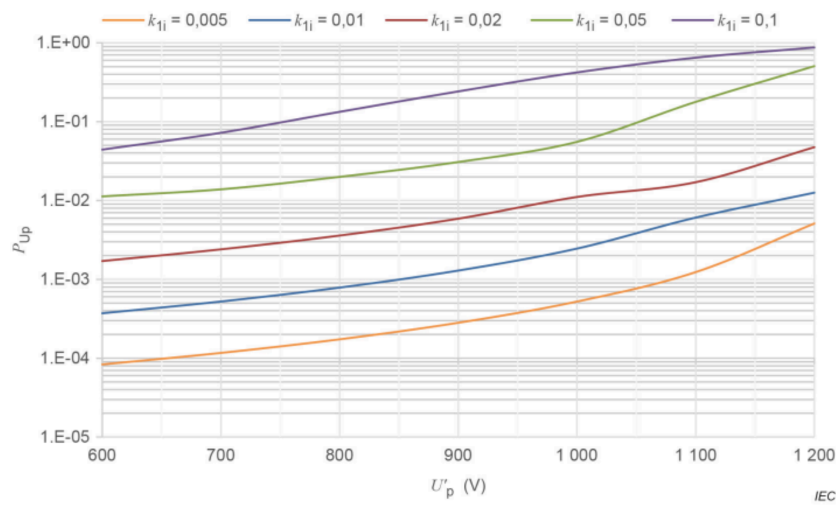


Figure D.4 – Probability P_{Up} as a function of the SPD2 residual voltage U_p' at 1 kA

D.3.2.5 Two SPDs: one voltage switching SPD and one voltage limiting SPD

When the required P_{SPD} cannot be achieved by only one voltage switching SPD at the entrance of the service into the structure, a second voltage limiting SPD (SPD2), which can withstand a charge coordinated with the charge of the first SPD, shall be installed.

The P_{SPD} of this coordinated SPD system is obtained adding the P_Q of the first SPD and the P_{Up} of the second SPD according to Equation (D.2).

These P_{Up} values as a function of the residual voltage at 1 kA (U_p') of SPD2 are reported in Figure D.5 for different k_{1i} parameter values, when U_w = 1,5 kV, l_c = 0,5 m, $n \times n' \geq 8$ and k_r > 1.

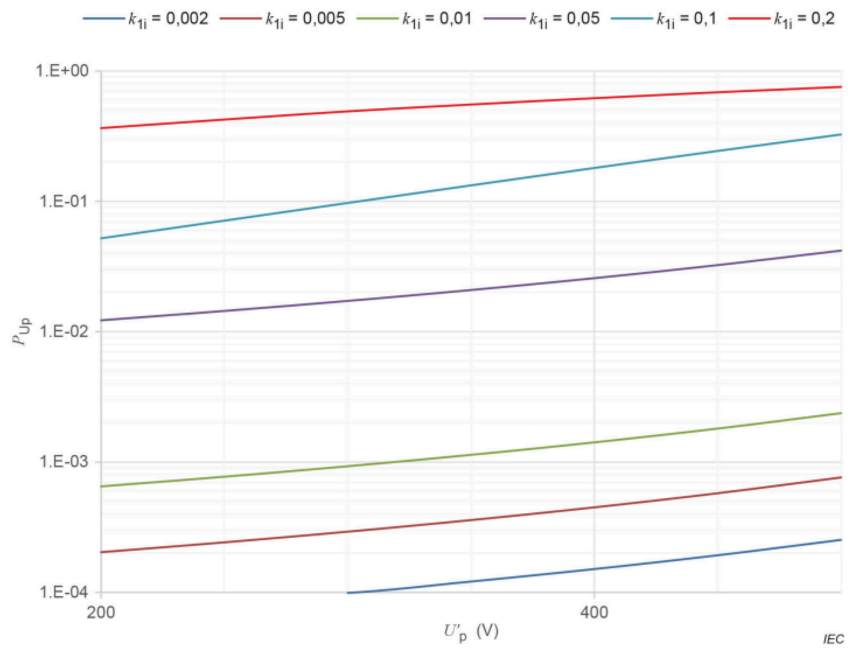


Figure D.5 – Probability P_{Up} as a function of the SPD2 residual voltage U_p' at 1 kA

D.3.3 Source of damage S3

D.3.3.1 One voltage limiting SPD

The P_{Up} values as a function of the residual voltage at 1 kA (U_p') are reported in Figure D.6 for different internal installation length values (l), when U_w = 2,5 kV, l_c = 0,5 m, n'= 4, k_r > 1, w = 0,005 m and external line length l_l is equal to 500 m.

EXAMPLE n' = 4, w = 0,1 m, l_v = 20 m, l_o = 80 m, l = 100 m, l_c = 0,5 m, U_w = 2,5 kV. Selecting a voltage limiting SPD with U_p' = 900 V, Figure D.6 indicates P_{Up} ≈ 0,125 when w = 0,005 m and n' = 4 conductors. However, Note 3 in Figure D.6 indicates that this value is multiplied by 1,4 when w = 0,1 m, then P_{Up} ≈ 0,125 × 1,4 = 0,175.

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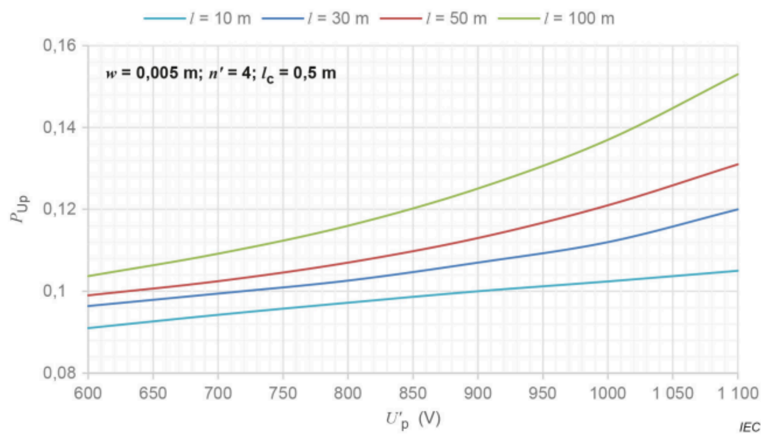

NOTE 1 For other line external lengths (l_l), the P_{Up} values are multiplied by the factor 500/l_l.

NOTE 2 When n' = 2, the P_{Up} values are multiplied by 1,4 (approximate values).

NOTE 3 When w = 0,1 m, the P_{Up} values are multiplied by 1,4 (approximate values).

Figure D.6 – Probability P_{Up} as a function of the residual voltage at 1 kA (U_p')

D.3.3.2 One voltage switching SPD

The P_{Up} values as a function of different internal installation length values (l), for two typical protection levels of GDTs, when U_w = 1,5 kV, l_c = 0,5 m, w = 0,1 m, k_r > 1 and external line length l_l = 500 m, are reported in Figure D.7 when n' = 20 conductors and in Figure D.8 when n' = 2 conductors.

NOTE The internal length of the circuit has been assumed to be 20 % vertical and 80 % horizontal (e.g. l = 30 m is composed by 6 m vertical and 24 m horizontal).

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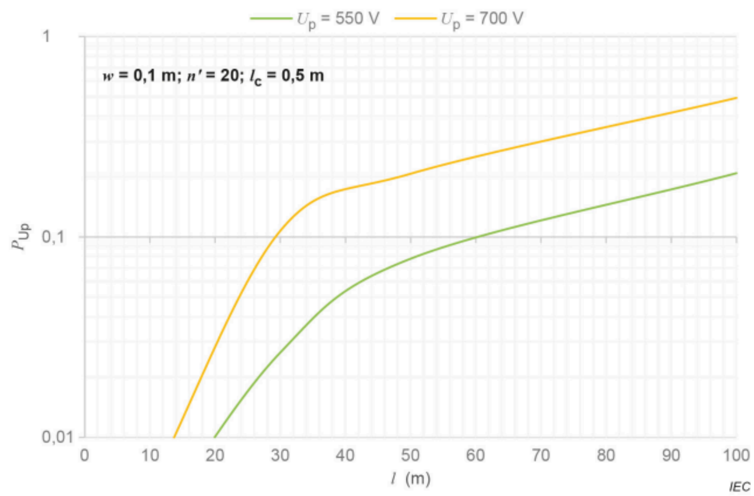
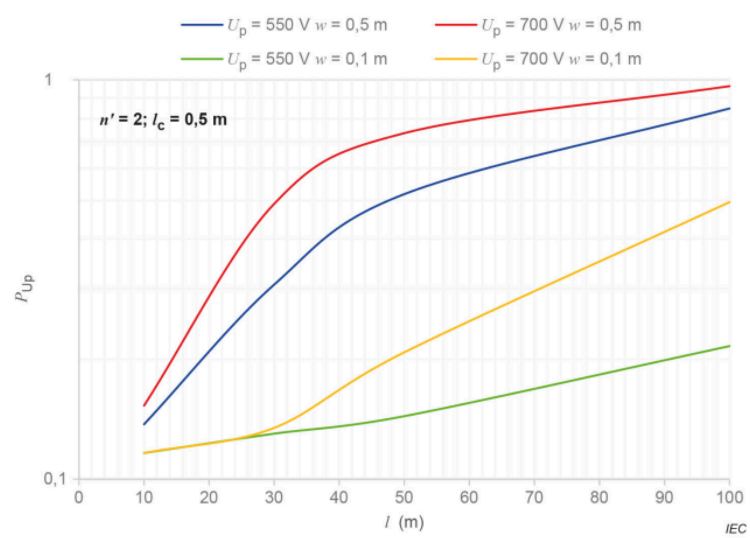


NOTE 1 For other external line lengths (l_l), the P_{Up} values are multiplied by the factor 500/l_l.

NOTE 2 When w = 0,005 m and n' = 20, the approximate P_{Up} value is 0,0034 for l_l = 500 m for both U_p values (550 V and 700 V). This value does not change significantly when the internal installation is shielded.

Figure D.7 – Probability P_{Up} as a function of different lengths of the internal circuit

EXAMPLE 2 unshielded conductors, 500 m external line length, U_w = 1,5 kV, l_c = 0,5 m, w = 0,1 m and l = 30 m. Installing GDTs with U_p = 550 V, Figure D.8 indicates P_{Up} = 0,134.



NOTE 1 For other external line lengths (l_l), the P_{Up} values are multiplied by the factor 500/l_l.

NOTE 2 When w = 0,5 m and n' = 20, the P_{Up} values do not change significantly.

NOTE 3 When w = 0,005 m and n' = 2, the approximate P_{Up} value is 0,12 for l_l = 500 m and for both U_p values (550 V and 700 V). This value does not change significantly when the internal installation is shielded.

D.3.3.3 Limiting type SPD and voltage switching SPD

When power is distributed according to the TT system, an SPD tested according to Class I tests can be installed upstream of the RCD. But in this case, protection against direct contact requires the installation of a voltage switching SPD between neutral and PE conductors (N-PE) in addition to voltage limiting SPDs between phase(s) and neutral conductors. In this case, it is possible to assume that the P_{Up} value is the greater value between that related to limiting or voltage switching SPDs.

Referring to typical installations where U_{w} = 2,5 kV and U_{p} = 1,5 kV of the voltage switching SPD, protection with only one SPD can be achieved only when k_{r} = 1, i.e. when the distance of the SPD from the equipment to be protected is less than 10 m and damage to the equipment does not cause danger to persons. In this case, the P_{Up} value is that related to the voltage limiting SPD. In this case, the P_{Up} values for a typical installation are reported in Table D.2 as a function of the protection level at 1 kA of the voltage limiting SPD.

Table D.2 – P_{Up} values of the voltage limiting SPD

n'	w m	l_{v} m	l_{o} m	l m	k_{r}	U_{p}' kV	P_{Up}
4	0,1	2	8	10	1	0,8	0,05
						1	0,07
						1,2	0,1
When w = 0,005 m, P_{Up} values should be multiplied by a factor 0,8.							

When k_{r} > 1, a second SPD voltage limiting SPD shall be installed for protecting the equipment power port.

D.3.3.4 Two voltage limiting SPDs

When the necessary P_{SPD} cannot be achieved by only one SPD at the entrance of the service into the structure, a second voltage limiting SPD (SPD2), which can withstand a charge coordinated with the charge of the first SPD, shall be installed.

The P_{SPD} of this coordinated SPD system is obtained adding the P_{Q} of the first SPD and the P_{Up} of the second SPD according to Equation (D.2).

These P_{Up} values as a function of the protection level at 1 kA (U_{p}') of SPD2 are reported in Figure D.9 for different internal installation lengths (l), when U_{w} = 2,5 kV, l_{c} = 0,5 m, w = 0,1 m, n' = 4 and k_{r} > 1.

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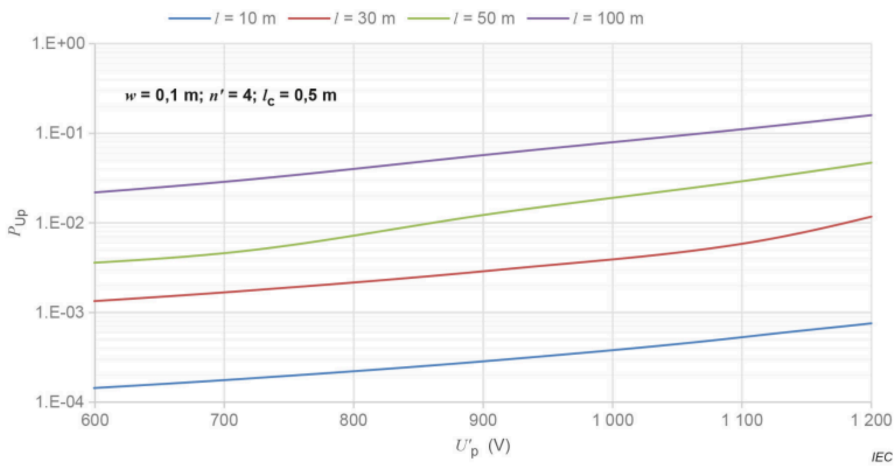

NOTE 1 For other line external lengths (l_l), the P_{Up} values are multiplied by the factor $500/l_l$.

NOTE 2 When n' = 2, the P_{Up} values are multiplied by 1,4 (approximate values).

NOTE 3 When w = 0,005 m, the P_{Up} values become almost negligible.

Figure D.9 – Probability P_{Up} as a function of the SPD2 residual voltage U_p' at 1 kA

D.3.4 Energy coordinated SPDs: One voltage switching SPD and one voltage limiting SPD downstream

When the necessary P_{SPD} cannot be achieved by only one SPD at the entrance of the service into the structure, a second voltage limiting SPD (SPD2), which can withstand a charge coordinated with the charge of the first SPD, shall be installed.

The P_{SPD} of this coordinated SPD system is obtained adding the P_Q of the first SPD and the P_{Up} of the second SPD according to Equation (D.2).

These P_{Up} values as a function of the protection level at 1 kA (U_p') of SPD2 are reported in Figure D.10 for different internal installation lengths (l), when U_w = 1,5 kV, l_c = 0,5 m, w = 0,1, n' = 2 and k_r > 1, in Figure D.11 when w = 0,5 m with n' = 2 or 20 conductors and in Figure D.12 when w = 0,1 and n' = 20 conductors.

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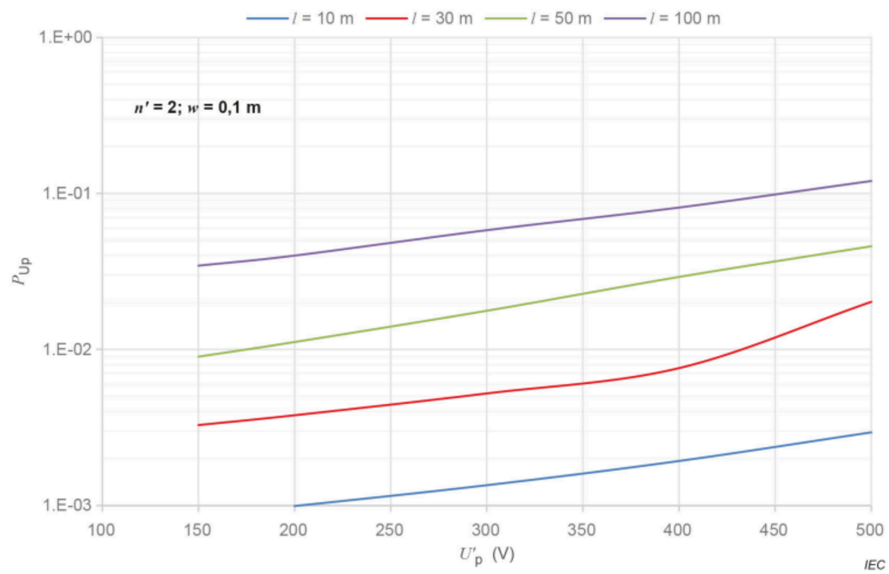
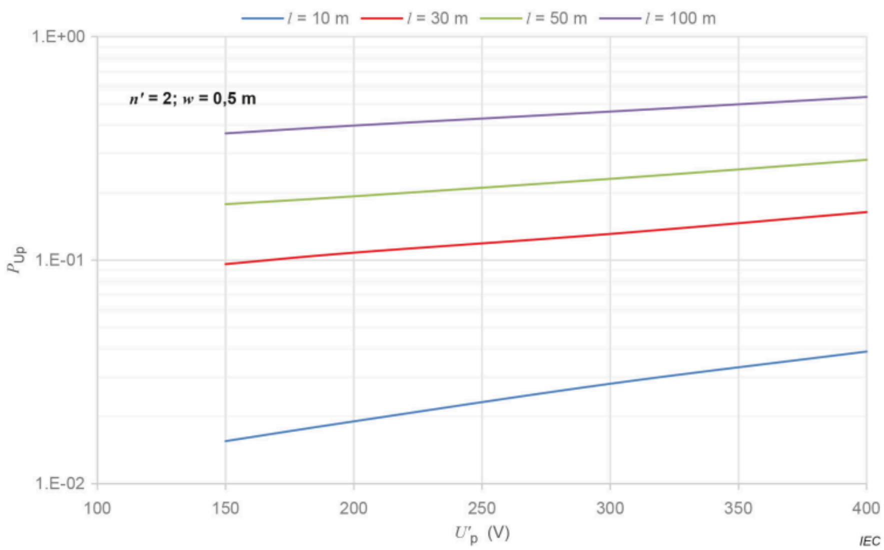


NOTE 1 For other external line lengths (l_l), the P_{Up} values are multiplied by the factor $500/l_l$.

NOTE 2 When n' = 4, the P_{Up} values are multiplied by 0,7 (approximate values).

NOTE 3 When w = 0,005 m and n' = 2, the P_{Up} values become almost negligible (P_{Up} = 0,000 4 when U_p' = 400 V and P_{Up} = 0,000 2 when U_p' = 200 V for the maximum length of 100 m).

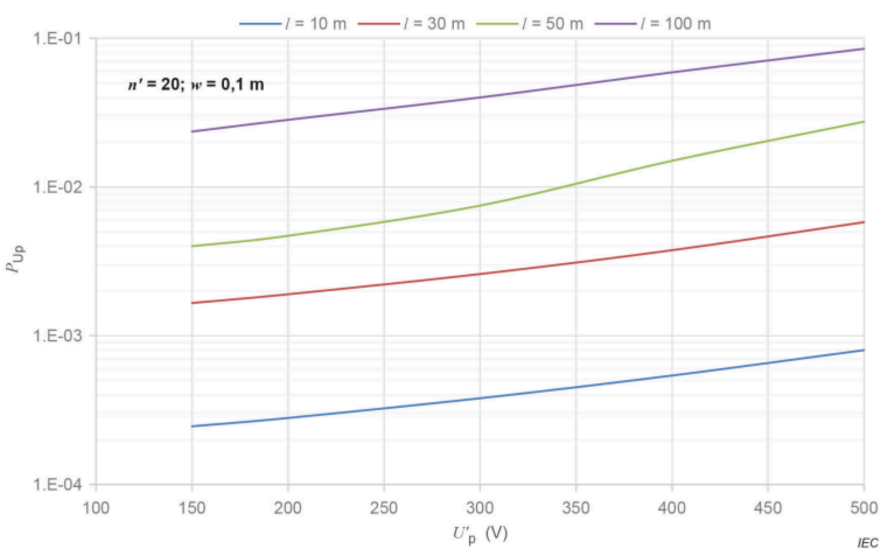
Figure D.10 – Probability P_{Up} as a function of the internal loop area for n' = 2 and w = 0,1 m



NOTE 1 For other external line lengths (ll), the P_{Up} values are multiplied by the factor 500/ll.

NOTE 2 Similar results to those shown in Figure D.11 can be obtained when n' = 20 with w = 0,5 m.

Figure D.11 – Probability P_{Up} as a function of the internal loop area for n' = 2 and w = 0,5 m



NOTE 1 For other line external lengths (l_l), the P_{Up} values are multiplied by the factor 500/l_l.

NOTE 2 When w = 0,005 m, the P_{Up} values become negligible.

Figure D.12 – Probability P_{Up} as a function of the internal loop area for n' = 20 and w = 0,1 m

D.4 Source of damage S4

D.4.1 One voltage limiting SPD

The P_{Up} evaluation as a function of the protection level at 1 kA (U_p') is reported in Figure D.13 for a different internal loop area as a function of the protection level at 1 kA (U_p'), when U_w = 2,5 kV, l_c = 0,5 m, n' = 4 and k_r is almost equal to 1.

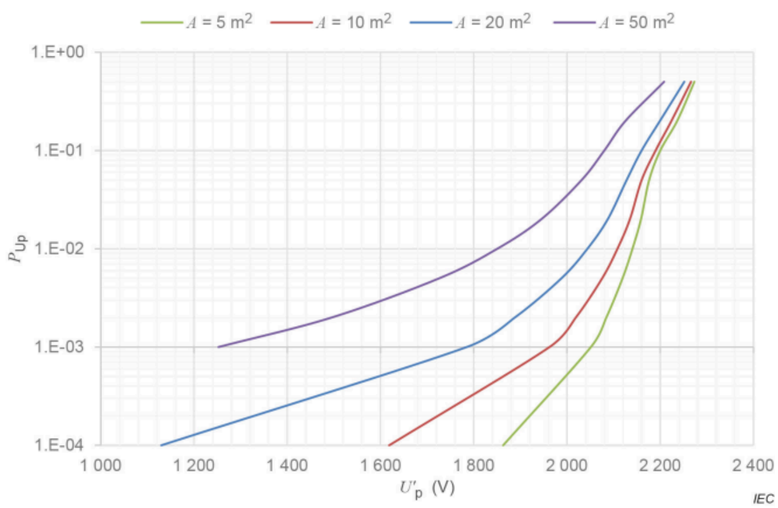


Figure D.13 – Probability P_{Up} as a function of the SPD protection level U_p' at 1 kA for different internal loop areas

EXAMPLE Figure D.13 shows that when w = 0,1 m and l = 100 m, the probability P_{Up} is about 0,000 1 when U_p' = 1,6 kV. An SPD tested according to Class II tests with I_n = 5 kA and U_p' ≤ 1,6 kV offers a P_{SPD} = 0,000 1 against source of damage S4.

D.4.2 One voltage switching SPD

The voltage switching SPD is typically used on telecommunication lines at the entrance of the structure and typical protection levels of GDTs are 700 V or 550 V.

Figure D.14 shows the P_{Up} evaluation as a function of a different internal loop area for the two typical U_p values of GDTs, i.e. 700 V and 550 V, when U_w = 1,5 kV, l_c = 0,5 m and k_r > 1.

EXAMPLE Figure D.14 shows that when U_w = 1,5 kV, w = 0,5 m and l = 100 m, the probability P_{Up} is about 0,004 when U_p' = 0,7 kV and P_{Up} = 0,002 when U_p' = 0,55 kV.

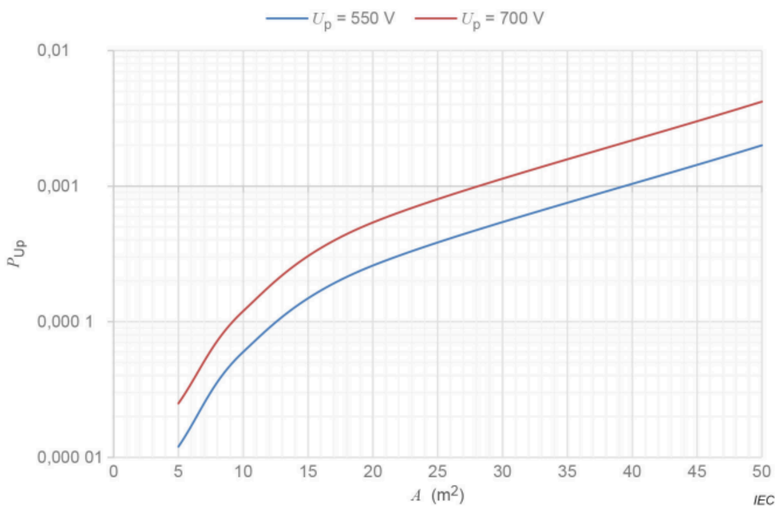


Figure D.14 – Probability P_{Up} as a function of different internal loop areas for two typical protection levels of GDTs

D.5 Source of damage S2

An SPD installed at the far end of the internal loop, from the equipment to be protected, cannot protect the equipment because the induced voltage in the loop between the SPD and equipment is not reduced and it is equal to the rated impulse voltage of the equipment (U_w).

Protection can be achieved by installing a voltage limiting SPD closer to the equipment in order to reduce the induction loop dimensions. This SPD can even be a second SPD coordinated with the first one located at the far end from the equipment to be protected.

Defining $S = w \times l$ the original loop dimension (m^2) and $S^* = w_1 \times l_1$ the loop dimensions (m^2) between this SPD and the equipment, the P_{Up} value is given by:

$$P_{Up} = [S^*/(U_w - -)]^2$$

where

U (V) is the protection level U_p of the switching type SPD or the residual voltage at 1 kA (U_p') of a limiting type SPD.

The P_{Up} values are the P_{SPD} values because the P_Q values are typically negligible when the nominal discharge current I_n is equal to or greater than 2,5 kA.

Annex E
(informative)

Detailed investigation of additional losses L_E related to surroundings

E.1 General

This Annex E is intended for specific applications. For most of the structures there is no need to calculate an environmental risk, but when necessary, it is possible to use this Annex E as a guidance.

Annex E describes a simple method to take into account damages to a structure which can involve surrounding structures or the environment by defining an additional loss L_E. If it is necessary to investigate the damage to a surrounding structure or the environment in more detail, the following concept described in Annex E can be used for calculating the additional loss L_E. With this concept, the influence of different characteristics and conditions of the structure struck by lightning and its surroundings to the additional losses at these surroundings can be considered in a more accurate way.

The following conditions are valid:

– In the surroundings the risk components R_{AT}, R_{AD} and R_U are not considered, because these are only relevant in the structure struck by lightning itself.

– Relevant for the surroundings are the following types of losses:

L_1: loss due to injury to human beings in the surroundings;

L_2: loss due to physical damage to the surroundings.

E.2 Calculation of risk components

The relevant components of the risk for the surroundings are calculated according to the equations given in Table E.1.

Table E.1 – Risk components for different sources of damage and types of loss, valid for damage to the surroundings

Type of loss	Source of damage			
	S1 Lightning flash to a structure	**S2 Lightning flash near a structure**	**S3 Lightning flash to an (incoming) line**	**S4 Lightning flash near a line**
L_1 Injury to living beings	R_{B1E} $= N_D \times P_B \times P_{PE} \times L_{B1E}$		R_{V1E} $= (N_L + N_{DJ}) \times P_V \times P_{PE} \times L_{V1E}$	
	R_{C1E} $= N_D \times P_C \times P_{PE} \times P_e \times L_{C1E}$ See footnote "a".	R_{M1E} $= N_M \times P_M \times P_{PE} \times P_e \times L_{M1E}$ See footnote "a".	R_{W1E} $= (N_L + N_{DJ}) \times P_W \times P_{PE} \times P_e \times L_{W1E}$ See footnote "a".	R_{Z1E} $= N_I \times P_Z \times P_{PE} \times P_e \times L_{Z1E}$ See footnote "a".
L_2 Physical damage	R_{B2E} $= N_D \times P_B \times L_{B2E}$		R_{V2E} $= (N_L + N_{DJ}) \times P_V \times L_{V2E}$	
	R_{C2E} $= N_D \times P_C \times P_e \times L_{C2E}$ See footnote "b".	R_{M2E} $= N_M \times P_M \times P_e \times L_{M2E}$ See footnote "b".	R_{W2E} $= (N_L + N_{DJ}) \times P_W \times P_e \times L_{W2E}$ See footnote "b".	R_{Z2E} $= N_I \times P_Z \times P_e \times L_{Z2E}$ See footnote "b".

[a] R_{C1E}, R_{M1E}, R_{W1E} and R_{Z1E} apply mainly for structures with a risk of explosion and for hospitals or other structures where failures of internal systems immediately endanger human life.

[b] R_{C2E}, R_{M2E}, R_{W2E} and R_{Z2E} apply mainly for structures with a risk of explosion.

where the general relations are given below:

$$L_{B1E} = L_{V1E} = L_{F1E} \tag{E.1}$$

$$L_{C1E} = L_{M1E} = L_{W1E} = L_{Z1E} = L_{O1E} \tag{E.2}$$

$$P_{PE} = t_{zE} / 8\,760 \tag{E.3}$$

$$L_{B2E} = L_{V2E} = L_{F2E} \tag{E.4}$$

$$L_{C2E} = L_{M2E} = L_{W2E} = L_{Z2E} = L_{O2E} \tag{E.5}$$

where

L_{F1E} is the typical mean ratio of persons injured by fire or explosion related to the total number of persons in the surroundings, due to one dangerous event (see Table E.3);

L_{O1E} is the typical mean ratio of persons injured by failure of internal systems related to the total number of persons in the surroundings, due to one dangerous event (see Table E.3);

L_{F2E} is the typical mean ratio of physical damage by fire or explosion related to the maximum extent of damage in the surroundings, due to one dangerous event (see Table E.4);

L_{O2E} is the typical mean ratio of physical damage by failure of internal systems related to the maximum extent of damage in the surroundings, due to one dangerous event (see Table E.4);

t_{zE} is the time of presence of persons in a potentially dangerous place in the surroundings (see Table E.2).

All these parameters are based on scenarios and should be evaluated precisely. When a scenario does not justify a component then this component should be taken equal to zero. For example, if an internal induced surge in a structure cannot create a scenario that itself creates a damage to a property outside the structure, then L_{M2E} should be taken equal to 0.

All the other parameters given in the equations of Table E.1 are used and calculated as described in Annex A and Annex B and in the main part of this document.

If values of t_{ZE} are unknown, t_{ZE}/8 760 = 1 should be assumed, as a matter of fact, in the surroundings of the structure, residential areas can exist with a permanent attendance of people.

Otherwise the values proposed in Table E.2 can be used. These values can be changed after detailed investigation.

Table E.2 – Type of loss L1: Proposed typical values for the related time of presence for people t_{zE}/8 760 in different environments as limited by Table E.3

Type of surrounding	t_{zE}/8 760[a]
Working site	0,25
Working site with operation with more than one shift	1,0
Structures open to the public	0,5
Zones of activities (industries and other activities not usually open to the public)	0,75
Residences	1
Roads	1
Railways	0,25
Inland waterways	0,1
Pedestrian ways	0,75
Open grounds and very infrequently attended areas (fields, meadows, forests, waste lands, marsh…)	0,25
Infrequently attended areas (horticultural gardens and zones, vineyards, fishing zones, marshalling yards …)	0,25
Normally or frequently attended areas (car parks, parks, zones of supervised baths, sports grounds)	0,5
Special cases (sporadic attendance)	0,1

[a] In case of "mixed" environments with different values, the highest value should be used.

For L_{F1E} and L_{O1E} the values given in Table E.3 are a proposal. More detailed calculations can be performed. When there is no risk for the surroundings, L_{F1E} = L_{O1E} = 0 should be assumed.

Table E.3 – Type of loss L1: Typical mean values of L_{F1E} and L_{O1E} outside the structure

Values of L_{F1E} and L_{O1E} Scenario	Environmental risk – Remaining inside the site fence		Environmental risk – Spreading outside of the site fence	
	L_{F1E} [g]	L_{O1E} [g]	L_{F1E}	L_{O1E}
Explosion and overpressure[a]	0,25	0,025	0,5	0,05
Thermal flux[b]	0,05	0,005	0,1	0,01
Toxic fumes[c]	0,1	0,01	1,0	0,1
Soil pollution[c]	0,1	0,01	0,5	0,05
Water pollution[c]	0,25[d]	0,025	2,5	0,25
Radioactive material[c e f]	0,5	0,05	5	0,5

[a] The overpressure exceeds a value of 5 kPa.

[b] The thermal power per area exceeds a value of 3 kW/m^2.

[c] These maximum values can be reduced based on quantity of pollutant, danger of the pollutant and sensitivity of the environment.

[d] Only if pollution can reach the water table or fresh water or sea or oceans.

[e] It is possible this will not be applicable when a specific study including all scenarios has been developed.

[f] This is not applicable to sealed sources for example used in measuring devices or medical equipment.

[g] In case of a TWS the values for L_{F1E} and L_{O1E} inside the site fence are multiplied by $(1 - P_{TWS})$.

For L_{F2E} and L_{O2E} the values given in Table E.4 are a proposal. More detailed calculations can be performed. When there is no risk for the surroundings, $L_{F2E} = L_{O2E} = 0$ should be assumed.

Table E.4 – Type of loss L2: Typical mean values of L_{F2E} and L_{O2E} outside the structure

Scenario	Environmental risk	
	L_{F2E}	L_{O2E}
Explosion and overpressure[a]	0,5	0,05
Thermal flux[b]	0,1	0,01
Toxic fumes[c]	0,5	0,05
Soil pollution[c]	0,2	0,02
Water pollution[c]	0,5[d]	0,05
Radioactive material[c e f]	1	0,1

[a] The overpressure exceeds a value of 14 kPa.

[b] The thermal power per area exceeds a value of 8 kW/m^2.

[c] These maximum values can be reduced based on quantity of pollutant, danger of the pollutant and sensitivity of the environment.

[d] Only if pollution can reach the water bed or fresh water or sea or oceans.

[e] It is possible this will not be applicable when a specific study including all scenarios has been developed.

[f] This is not applicable to sealed sources for example used in measuring devices or medical equipment.

Annex F
(informative)

Case studies

F.1 General

In this Annex F, case studies relevant to a house, an office building and a hospital are developed with the aim of showing, for risk and frequency of damage:

- how to calculate with the value of parameters and determine the need for protection;
- the contribution of different components to the overall value;
- the effect of different protection measures to mitigate both the risk and the frequency of damage.

NOTE This Annex F presents hypothetical data for all cases. It is intended to provide information about risk and frequency of damage evaluation in order to illustrate the principles contained in this document. It is not intended to address the unique aspects of the conditions that exist in all facilities or systems.

For simplicity some factors will be shown as follows:

$R_B = R_{B1} + R_{B2}$

$R_C = R_{C1} + R_{C2}$

$R_M = R_{M1} + R_{M2}$

$R_V = R_{V1} + R_{V2}$

$R_W = R_{W1} + R_{W2}$

$R_Z = R_{Z1} + R_{Z2}$

The dash (–) in tables means "not applicable".

The risk and frequency values calculated in tables are fixed to 3 decimal places. Smaller values are therefore expressed as ≈ 0.

Owing to rounded values used for calculation, one can obtain slightly different results for calculated values.

F.2 House

F.2.1 Relevant data and characteristics

NOTE Throughout this example, additional subscripts P, T and D have been added to existing parameters to signify power, telecom and data lines respectively.

The house has no existing lightning protection and is located in flat territory without any neighbouring structures. The lightning ground strike-point density is N_{SG} = 8 (strike-points/km^2/year). The house is inhabited for six months a year. It is assumed that there is nobody outside the house during a thunderstorm.

The house is fed by one low-voltage aerial (overhead) power line and one aerial telephone line; no external conductive parts are connected to the house.

Data for the house and its surroundings are given in Table F.1.

Data for the incoming lines and their internal systems connected to these lines are given in Table F.2 for the power line and in Table F.3 for the telecom line. The last column provides locations where the values selected can be found or the process used to determine the value. In Table F.1, the source of the LLS data cannot provide the value of k so the default value of 2 is used. The structure provides no shielding against LEMP so the default value of K_{S1} is selected. There is no thunderstorm warning system (TWS) in use at the structure. In places where there is no justification nor reference to specific clauses, the values have been selected for the purpose of the example.

Table F.1 – House: environment and structure characteristics

Input parameter	Comment	Symbol	Value	Reference
Lightning ground strike-point density (strike-points/km^2/year)		N_{SG}	8,0	
Factor relating N_G to N_{SG}		k	2	Clause A.1
Structure dimensions (m)		L, W, H	15, 20, 6	
Location factor of structure	Isolated structure	C_D	1	Table A.1
Construction material	Masonry	P_S	1	Table B.4
Structure shielding	None	K_{S1}	1	Clause B.6
Environmental factor	Rural	C_E	1	Table A.4
LPS	None	P_{LPS}	1	Table B.3
TWS	None	P_{TWS}	1	Clause B.1

Table F.2 – House: power line

Input parameter	Comment	Symbol	Value	Reference
Length (m)[a]		L_L	1 000	Clause A.4
Installation factor	Aerial	C_{IP}	1	Table A.2
Line type factor	LV line	C_{TP}	1	Table A.3
Environmental factor	Rural	C_{EP}	1	Table A.4
Shielding, grounding, isolation	None	C_{LDP}	1	Table B.9
		C_{LIP}	1	
Equipotential bonding	None	P_{EBP}	1	Table B.13
Adjacent structure	None	L_J, W_J, H_J	–	
Location factor of structure	None	C_{DJ}	–	Table A.1
Withstand voltage of internal system (kV)		U_{WP}	2,5	
Number of conductors	Three phase conductors + neutral	n_P	4	Table B.7
	Resulting parameter	P_{LDP}	1	Table B.11
Lateral distance for $S2$ (m)	U_{WP} is higher than U_{WT}	r_{MP}	-	Not used, see Equation (A.8) and Table F.3
Lateral distance for $S4$ (m)		r_{IP}	384	2 000/$U_{WP}^{1.8}$, see Equation (A.12)

[a] As the length L_L of the line section is unknown, L_L = 1 000 m is assumed (Clause A.4).

Table F.3 – House: telecom line

Input parameter	Comment	Symbol	Value	Reference
Length (m)		L_L	800	Clause A.4
Installation factor	Aerial	C_{IT}	1	Table A.2
Line type factor	Telecom line	C_{TT}	1	Table A.3
Environmental factor	Rural	C_{ET}	1	Table A.4
Shielding, grounding, isolation	None	C_{LDT}	1	Table B.8
		C_{LIT}	1	
Equipotential bonding	None	P_{EBT}	1	Table B.13
Adjacent structure	None	L_J, W_J, H_J	–	The telecom cabinet at the other end of the line is too small to be considered
Location factor of structure	Isolated structure	C_{DJ}	–	Table A.1
Withstand voltage of internal system (kV)		U_{WT}	1,5	
Number of conductors		n_T	2	Table B.8
	Resulting parameter	P_{LDT}	1	Table B.11
Lateral distance for S2 (m)	U_{WT} is lower than U_{WP}	r_{MT}	233	$350/U_{WT}$, see Equation (A.8)
Lateral distance for S4 (m)		r_{IT}	964	$2\,000/U_{WT}^{1.8}$, see Equation (A.12)

F.2.2 Calculation of expected annual number of dangerous events

Calculations are given in Table F.4 for the equivalent collection areas and in Table F.5 for the expected number of dangerous events.

Table F.4 – House: equivalent collection areas of structure and lines

	Symbol	Result m^2	Reference
Structure	A_D	$2,58 \times 10^3$	A.2.1.2, Equation (A.3)
	A_M	$1,87 \times 10^5$	Clause A.3, Equation (A.8)
Power line	A_{LP}	$4,00 \times 10^4$	Clause A.4, Equation (A.10)
	A_{IP}	$7,69 \times 10^5$	Clause A.5, Equation (A.12)
Telecom line	A_{LT}	$3,20 \times 10^4$	Clause A.4, Equation (A.10)
	A_{IT}	$1,54 \times 10^6$	Clause A.5, Equation (A.12)

Table F.5 – House: expected annual number of dangerous events

	Symbol	Result 1/year	Reference
Structure	N_D	$2,06 \times 10^{-2}$	A.2.4, Equation (A.5)
	N_M	$7,5 \times 10^{-1}$	Clause A.3, Equation (A.7)
Power line	N_{LP}	$3,2 \times 10^{-1}$	Clause A.4, Equation (A.9)
	N_{IP}	3,07	Clause A.5, Equation (A.11)
Telecom line	N_{LT}	$2,56 \times 10^{-1}$	Clause A.4, Equation (A.9)
	N_{IT}	6,17	Clause A.5, Equation (A.11)

F.2.3 Risk management

As a first step, the risk zones should be identified in which the structure can be divided. For each risk zone, both the risk R and the frequency of damage F to internal systems are assessed.

This implies:

a) the need to determine the risk R and to compare it with the tolerable risk $R_T = 10^{-5}$ (7.3). If necessary, suitable protection measures to mitigate such risk should be selected.

   Risk components are evaluated according to Table 3.

b) the need to determine the frequency of damage F and to compare it with the required tolerable frequency of damage F_T (9.3). In this case the tolerable frequency of damage was fixed by the owner of the building to the value $F_T = 10^{-1}$. Therefore, if necessary, suitable protection measures to reduce such frequency of damage should be selected. Frequency of damage components are evaluated according to Table 4.

In this example, only the risk is calculated. Frequency of damages are addressed in the other examples.

F.2.4 Definition of risk zones in the house

The following main risk zones can be defined as follows:

Z_1 (outside the building);

Z_2 (inside the building) is defined taking into account that:

- both internal systems (power and telecom) extend throughout the building,
- no spatial shields exist,
- the structure is a single fireproof compartment,
- losses are assumed to be constant in all the building and to correspond to the typical mean values of Table C.2.

The values of time of annual attendance of persons in each risk zone and the risk components to be considered are shown in Table F.6. Time outside the building is very limited and thus for the purpose of this example it is assumed that there is nobody outside the building (as a consequence Z_1 is ignored).

Table F.6 – House: time of presence of persons and risk components into risk zones

Risk zone	Time of presence hours/year	Risk components								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_2 (inside the building)	4 380	X		X			X	X		

For zone Z_1, as there is nobody outside the building, the risk of shock to people R_{AT} = 0. It is also assumed that there are no electrical systems outside the building and then the frequency of damage F = 0.

The defined parameters for zone Z_2 are reported in Table F.7.

Table F.7 – House: values for zone Z_2 (inside the building)

Input parameter		Comment	Symbol	Value	Reference
Type of floor		Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)		None	P_{am}	1	Table B.1
Position of persons in the exposed area		Not applicable	P_o	0	Clause B.3
Risk of fire		Low	r_f	10^{-3}	Table B.6
Fire protection		None	r_p	1	Table B.5
Factor for persons in zone		t_z/8 760 = 4 380/8 760	P_P	0,5	Equation (B.14)
Factor for equipment in zone		t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
Zone shielding		None	K_{S2}	1	Equation (B.9)
Power internal system	Internal wiring	Unshielded conductors routed in the same conduit	K_{S3P}	2 × 10^{-1}	Table B.10
	Withstand voltage factor (kV)		U_{WP}	2,5	
	SPD system	None	P_{SPD}	1	Table B.7
Telecom internal system	Internal wiring	Unshielded conductors with different routing	K_{S3T}	1	Table B.10
	Withstand voltage factor (kV)		U_{WT}	1,5	
	SPD system	None	P_{SPD}	1	Table B.8
Type of zone according to loss		Low loss zone	-	-	Table C.2

Input parameter	Comment	Symbol	Value	Reference
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	
	Persons injured by fire	L_{F1}	2×10^{-2}	
	Physical damage due to fire	L_{F2}	2×10^{-2}	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	10^{-1}	

F.2.5 Risk assessment

The risk R can be expressed according to Equation (1). Involved components are given in Table F.6 and risk values are given in Table F.8.

Table F.8 – House: risk for the unprotected structure (values × 10^{-5})

Symbol	Z_2
R_{AT}	≈ 0
R_B	0,062
R_U	0,003
R_V	1,728
R	1,793
R_T	1

Because the risk R is higher than the tolerable value R_T = 10^{-5}, lightning protection for the structure is required to mitigate the risk.

F.2.6 Risk – Selection of protection measures

According to Table F.8 the main contribution to the value of risk is given by component R_V (lightning flash to lines) and reducing this component can be enough to reduce the risk below the tolerable level.

To reduce the risk R to a tolerable value, the protective measures influencing the components R_V should be considered. Suitable measures are SPDs of LPL IV installed on power and telephone lines at the entrance point in the house (equipotential bonding). According to Table F.7 this reduces the value of P_{EB} (due to SPDs on connected lines) from 1 to 0,05 and the values of P_V by the same factor. Inserting these values into the equations, new values of risk components are obtained, as shown in Table F.9 and this table shows that the total risk is by now lower than the tolerable level.

Table F.9 – House: risk components for protected structure (values × 10^{-5})

Symbol	Z_2
R_{AT}	≈ 0
R_B	0,062
R_U	≈ 0
R_V	0,086
R	0,149
R_T	1

F.2.7 Conclusions

The risk R can be reduced below the tolerable level by installing an SPD tested according to Class I test of LPL IV for both power and telephone lines.

F.3 Office building

F.3.1 Relevant data and characteristics

As a second case study, an office building with an archive, offices and a computer centre is considered.

The office building is located in flat territory without any neighbouring structures. The lightning striking point to ground density is N_{SG} = 4 (strike-points/km^2/year).

The office building is fed by one power line and one telecommunication line. In addition, one external conductive part is connected to the structure (water pipe). The external telecommunication line is made of a metal free fibre optic cable but the internal telecommunication line is made of unshielded copper line.

Data for the building and its surroundings are given in Table F.10. Data for the incoming lines and their connected internal systems are given in Table F.11 for the power line and in Table F.12 for the telecom line.

Table F.10 – Office building: environment and structure characteristics

Input parameter	Comment	Symbol	Value	Reference
Lightning ground strike-point density (strike-points/km^2/year)		N_{SG}	4,0	
Factor relating N_G to N_{SG}		k	2	Clause A.1
Structure dimensions (m)		L, W, H	20, 40, 25	
Location factor of structure	Isolated structure	C_D	1	Table A.1
Construction material	Reinforced concrete	P_S	0,5	Table B.4
Structure shielding	None	K_{S1}	1	Equation (B.8)
Environmental factor	Suburban	C_E	0,5	Table A.4
LPS	None	P_{LPS}	1	Table B.3
TWS	None	P_{TWS}	1	Clause B.1

Table F.11 – Office building: power line

Input parameter		Comment	Symbol	Value	Reference
HV section	Length (m)		L_L	1 000	Clause A.4
	Installation factor	Buried	C_I	0,3	Table A.2
	Line type factor	HV line	C_T	0,2	Table A.3
	Environmental factor	Suburban	C_E	0,5	Table A.4
	Shield of line (Ω/km)	Unshielded	R_S	–	
LV section	Length (m)		L_L	100	
	Installation factor	Buried	C_I	0,3	Table A.2
	Line type factor	LV line	C_T	1	Table A.3
	Environmental factor	Suburban	C_E	0,5	Table A.4
	Shield of line (Ω/km)	Unshielded	R_S	–	
Shielding, grounding, isolation		None	C_{LD}	1	Table B.9
			C_{LI}	1	
Equipotential bonding		None	P_{EB}	1	Table B.13
Adjacent structure		None	L_J, W_J, H_J	–	HV line is 1 km long
Location factor of adjacent structure		None	C_{DJ}	–	Table A.1
Withstand voltage of internal system (kV)			U_{WP}	2,5	
Number of conductors		3 phase conductors + neutral	n_P	4	Table B.7
		Resulting parameter	P_{LD}	1	Table B.11 and Table B.12
Lateral distance for S2 (m)		U_{WP} is higher than U_{WT}	r_{MP}	-	Not used, see Equation (A.8) and Table F.12
Lateral distance for S4 (m)			r_{IP}	384	2 000/$U_{WP}^{1.8}$, see Equation (A.12)

Table F.12 – Office building: telecom line

Input parameter	Comment	Symbol	Value	Reference
Length (m)	Fibre optic cable	L_L	0	Clause A.4
Withstand voltage of internal system (kV) connected to internal telecommunication copper unshielded line		U_{WT}	1,5	
Lateral distance for S2 (m)	U_{WT} is lower than U_{WP}	r_{MT}	233	350/U_{WT}, see Equation (A.8)

F.3.2 Calculation of expected annual number of dangerous events

The results of calculations are given in Table F.13 for the collection areas and in Table F.14 for the expected number of dangerous events.

Table F.13 – Office building: collection areas of structure and lines

	Symbol	Result m^2	Reference Equation
Structure	A_D	$2,75 \times 10^4$	Equation (A.3)
	A_M	$1,99 \times 10^5$	Equation (A.8)
Power line	A_{LP1}	4×10^4	Equation (A.10)
	A_{IP1}	$7,69 \times 10^5$	Equation (A.12)
	A_{LP2}	4×10^3	Equation (A.10)
	A_{IP2}	$7,69 \times 10^4$	Equation (A.12)
Telecom line	A_{LT}	0	Equation (A.10)
	A_{IT}	0	Equation (A.12)

Table F.14 – Office building: expected annual number of dangerous events

	Symbol	Result 1/year	Reference Equation
Structure	N_D	$1,1 \times 10^{-1}$	Equation (A.5)
	N_M	$3,98 \times 10^{-1}$	Equation (A.7)
Power line	N_{LP1}	$4,8 \times 10^{-3}$	Equation (A.9)
	N_{IP1}	$4,61 \times 10^{-2}$	Equation (A.11)
	N_{LP2}	$2,4 \times 10^{-3}$	Equation (A.9)
	N_{IP2}	$2,31 \times 10^{-2}$	Equation (A.11)
Telecom Line	N_{LT}	0	Equation (A.9)
	N_{IT}	0	Equation (A.11)

F.3.3 Risk management

As a first step, the zones in which the structure can be divided should be identified. For each zone, both the risk R of public loss and the frequency of damage F to internal systems shall be assessed.

This implies:

a) the need to determine the risk R and to compare it with the tolerable risk $R_T = 10^{-5}$ (7.3). If necessary, suitable protection measures to mitigate such risk will be selected. Risk components will be evaluated according to Table 3;

b) the need to determine the frequency of damage F and to compare it with the required tolerable risk F_T (9.3). In this case, based on technical-economical evaluations relevant to the service exploited in the building, the tolerable frequency of damage was fixed by the Technical Director of the company to the value $F_T = 5 \times 10^{-2}$. Therefore, if necessary, suitable protection measures to reduce such frequency of damage should be selected. Frequency of damage components will be evaluated according to Table 4.

F.3.4 Definition of zones in the office building

The following zones are defined:

Z_1 (entrance area outside);

Z_2 (roof);

Z_3 (archive);

Z_4 (offices);

Z_5 (computer centre);

taking into account that:

- the roof is accessible to people;
- the structure is divided into two separate fireproof compartments: the first is the archive (Z_3) and the second is the offices together with the computer centre (Z_4 and Z_5);
- in all inner zones, Z_3, Z_4 and Z_5, internal systems connected to the power as well as to the telecom line exist;
- no spatial shields exist;
- people in the two outside zones, Z_1 and Z_2, are protected by the structure or its external LPS from a direct strike and therefore in this example it is not necessary to calculate R_B for these zones;
- people in the two outside zones, Z_1 and Z_2, are not protected from step and touch voltages caused by a direct strike to the structure and therefore it is necessary to calculate R_{AT} for these zones.

The use of values less than 1 for r_p has been selected in agreement with the building owner, see Clause B.4.

The values of time of annual attendance of persons in each zone and the risk components to be considered are shown in Table F.15.

Table F.15 – Office building: time of presence of persons and risk components in zones

Zone	Time of presence hours/year	Risk components								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_1 (entrance outside)	175	X								
Z_2 (roof)	18	X	X							
Z_3 (archive)	440	X		X			X	X		
Z_4 (offices)	2 630	X		X			X	X		
Z_5 (computer centre)	2 200	X		X			X	X		

The relevant parameters for the zones Z_1 to Z_5 are given in Table F.16 to Table F.20.

Table F.16 – Office building: factors valid for zone Z_1 (entrance area outside)

Input parameter	Comment	Symbol	Value	Reference
Ground surface	Marble	r_t	10^{-3}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	None	r_f	0	Table B.6
Fire protection	None	r_p	1	Table B.5
Factor for persons in zone	t_z/8 760 = 175/8 760	P_P	0,02	Equation (B.14)
Factor for equipment in zone	Not applicable	P_e	-	Equation (B.15)
SPD system (Power line)	No internal systems	P_{SPD}	1	Table B.7
SPD system (Telecom line)	No internal systems	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	No internal systems	K_{S3}	0	Table B.10
Internal wiring (Telecom line)	No internal systems		0	
Type of zone according to loss	Low loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	
	Persons injured by fire	L_{F1}	-	
	Physical damage due to fire	L_{F2}	-	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	-	

Table F.17 – Office building: factors valid for zone Z_2 (roof)

Input parameter	Comment	Symbol	Value	Reference
Ground surface	Asphalt	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Maintenance team present in the exposed area	P_o	1	Clause B.3
Risk of fire	None	r_f	0	Table B.6
Fire protection	None	r_p	1	Table B.5
Factor for persons in zone	t_z/8 760 = 18/8 760	P_P	0,002	Equation (B.14)
Factor for equipment in zone	Not applicable	P_e	-	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	-	Table B.7
SPD system (Telecom line)	None	P_{SPD}	-	Table B.8

Input parameter	Comment	Symbol	Value	Reference
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	No internal systems	K_{S3}	-	Table B.10
Internal wiring (Telecom line)				
Type of zone according to loss	Low loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	10^{-1}	
	Persons injured by fire	L_{F1}	-	
	Physical damage due to fire	L_{F2}	-	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	-	

Table F.18 – Office building: factors valid for zone Z_3 (archive)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	High	r_f	10^{-1}	Table B.6
Fire protection	Automatic alarm	r_p	0,2	Table B.5
Factor for persons in zone	t_z/8 760 = 440/8 760	P_P	0,05	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same conduit)	K_{S3}	0,2	Table B.10
Internal wiring (Telecom line)	Unshielded (loop conductors with different routing)		1	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	U_W = 1,5 kV			
Type of zone according to loss	Normal loss zone	-	-	Table C.2

Input parameter	Comment	Symbol	Value	Reference
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	
	Persons injured by fire	L_{F1}	5×10^{-2}	
	Physical damage due to fire	L_{F2}	5×10^{-2}	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	5×10^{-2}	

Table F.19 – Office building: factors valid for zone Z_4 (offices)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	Low	r_f	10^{-3}	Table B.6
Fire protection	Extinguishers	r_p	0,5	Table B.5
Factor for persons in zone	t_z/8 760 = 2 630/8 760	P_P	0,3	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same conduit)	K_{S3}	0,2	Table B.10
Internal wiring (Telecom line)	Unshielded (loop conductors with different routing)		1	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	U_W = 1,5 kV			
Type of zone according to loss	Normal loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	
	Persons injured by fire	L_{F1}	5×10^{-2}	
	Physical damage due to fire	L_{F2}	5×10^{-2}	
	Persons injured by failure of internal systems	L_O	-	

Input parameter	Comment	Symbol	Value	Reference
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	5×10^{-2}	

Table F.20 – Office building: factors valid for zone Z_5 (computer centre)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	Low	r_f	10^{-3}	Table B.6
Fire protection	Automatic alarm installation	r_p	0,2	Table B.5
Factor for persons in zone	t_z/8 760 = 2 200/8 760	P_P	0,25	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same conduit)	K_{S3}	0,2	Table B.10
Internal wiring (Telecom line)	Unshielded (loop conductors with different routing)		1	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	U_W = 1,5 kV			
Type of zone according to loss	High loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	
	Persons injured by fire	L_{F1}	10^{-1}	
	Physical damage due to fire	L_{F2}	10^{-1}	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	5×10^{-2}	

F.3.5 Risk assessment

The risk R can be expressed according to Equation (1). Involved components are given in Table F.15 and risk values are given in Table F.21.

Table F.21 – Office building: risk for the unprotected structure (values × 10^{-5})

Symbol	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,002	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	2,259	-	-	-
R_B	-	-	5,770	0,179	0,137
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,756	0,023	0,018
R	0,002	2,259	6,526	0,202	0,156
R_T	1				

Because in zones Z_2 and Z_3 the risk is higher than the tolerable value $R_T = 10^{-5}$, lightning protection for the structure is required to mitigate the risk in these zones.

F.3.6 Frequency of damage assessment

The frequency of damage F can be expressed according to Equation (12). Frequency components are to be evaluated according to Clause 9.2. Involved components and frequency of damage evaluation are given in Table F.22.

Table F.22 – Office building: frequency of damage for the unprotected structure

Symbol	Z_1	Z_2	Z_3	Z_4	Z_5
F_C	-	-	0,11	0,11	0,11
F_M	-	-	0,398	0,398	0,398
F_{WP}	-	-	0,007	0,007	0,007
F_{WT}	-	-	-	-	-
F_{ZP}	-	-	0,0692	0,0692	0,0692
F_{ZT}	-	-	-	-	-
F	-	-	0,584	0,584	0,584
F_T	-	-	0,05	0,05	0,05

Because in all zones where internal systems are installed, F is higher than the tolerable value $F_T = 5 \times 10^{-2}$, lightning protection for the structure is required to reduce the frequency of damage.

F.3.7 Risk – Selection of protection measures

According to Table F.21, the zone at a higher risk is zone Z_3 (archive) because of the high value of risk of fire (risk components R_B and R_V).

Suitable protection measures to reduce the risk R in zone Z_3 are to install an LPL II LPS for protection of the building, thus reducing the risk component R_B in zones Z_2, Z_3, Z_4 and Z_5. According to Table B.3 this reduces the value of P_{LPS} from 1 to 0,05 and the value of P_{EB} from 1 to 0,02 (due to SPDs on connected lines) and finally the values of P_U and P_V by the same factor.

For the equipotential bonding, the LPS is equipped with SPDs installed on the power line, at the entrance of the line in the structure.

By applying these protection measures, new values of risk components are obtained, as shown in Table F.23.

Table F.23 – Risk components for protected structure (values × 10^{-5})

Symbol	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	0,113	-	-	-
R_B	-	-	0,577	0,018	0,014
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,015	≈ 0	≈ 0
R	≈ 0	0,113	0,592	0,018	0,014
R_T	1				

F.3.8 Frequency of damage – Selection of protection measures

To reduce the frequency of damage F to the required value ($F_T = 5 \times 10^{-2}$), the suitable measure is to install a coordinated SPD system to protect internal systems connected to the power line.

The telecom line inside the building is a copper unshielded line and thus protection of telecom equipment is also necessary as it has an impact on components F_C and F_M.

According to Table F.22: for coordinated SPD systems, LPL II to protect internal systems connected to the power line is suitable. The same level LPL II is used for the SPD protecting the internal telecom equipment.

Such an SPD system reduces the value of P_{SPD} relevant to the frequency of damage F_1 in zones Z_3, Z_4 and Z_5 from 1 to 0,02; it reduces also the value of P_{SPD} relevant to frequencies of damage F_2, F_3 and F_4. The new values of frequency of damage components are shown in Table F.24.

Table F.24 – Office building: frequency of damage for protected structure

Symbol	Z_3	Z_4	Z_5
F_C	0,004	0,004	0,004
F_M	0,008	0,008	0,008
F_{WP}	≈ 0	≈ 0	≈ 0
F_{WT}	-	-	-
F_{ZP}	0,001	0,001	0,001
F_{ZT}	-	-	-
F	0,014	0,014	0,014
F_T	0,05	0,05	0,05

F.3.9 Conclusions

Both risk R and frequency of damage F can be reduced below the tolerable level by installing:

- an LPL II LPS for protection of the building,
- a coordinated LPL II SPD system for power systems and an LPL II SPD for telecom equipment.

NOTE As indicated in Clause B.4, the fire alarm has been taken into account in the risk calculation because it was protected against overvoltages and other damages and firefighters can arrive in less than 10 min.

F.4 Hospital

F.4.1 Relevant data and characteristics

As a more complex case, this study considers a standard hospital facility with a rooms block, an operating block and an intensive care unit.

The hospital is located in flat territory without any neighbouring structures. The lightning striking point to ground density is N_{SG} = 8 (strike-points /km^2/year).

The hospital is fed by one power line and one telecommunication line; two external conductive parts are connected to the structure (water pipe and gas pipe).

The telecommunication line is made of metal free fibre optic, as well as the internal systems connected to it. Since it is not possible to transmit or induce surges on fibre optic lines or circuits, these lines and internal systems can be neglected in the risk assessment and the frequency of damage assessment.

Data for the building and its surroundings are given in Table F.25.

Data for the incoming power line and the internal systems connected thereto are given in Table F.26.

Table F.25 – Hospital: environment and structure characteristics

Input parameter	Comment	Symbol	Value	Reference
Lightning ground strike-point density (strike-points /km^2/year)		N_{SG}	8,0	
Factor relating N_G to N_{SG}		k	2	Clause A.1
Structure dimensions (m)		L, W, H	50, 150, 10	
Location factor of structure	Isolated structure	C_D	1	A.2.3, Table A.1
Construction material	Reinforced concrete	P_S	0,5	Clause B.4, Table B.4
Structure shielding	None	K_{S1}	1	Clause B.6, Equation (B.8)
Environmental factor	Suburban	C_E	0,5	Clause A.4, Table A.4
LPS	None	P_{LPS}	1	Clause B.3, Table B.3
TWS	None	P_{TWS}	1	Clause B.1

Table F.26 – Hospital: power line

Input parameter		Comment	Symbol	Value	Reference
HV section	Length (m)		L_L	1 000	Clause A.4
	Installation factor	Buried	C_I	0,3	Table A.2
	Line type factor	HV line	C_T	0,2	Table A.3
	Environmental factor	Suburban	C_E	0,5	Table A.4
	Shield of line (Ω/km)	Unshielded	R_S	–	
LV section	Length (m)		L_L	50	
	Installation factor	Buried	C_I	0,3	Table A.2
	Line type factor	LV line	C_T	1	Table A.3
	Environmental factor	Suburban	C_E	0,5	Table A.4
	Shield of line (Ω/km)	Unshielded	R_S	–	
Shielding, grounding, isolation		None	C_{LD}	1	Table B.9
			C_{LI}	1	
Equipotential bonding		None	P_{EB}	1	Table B.13
Adjacent structure		None	L_J, W_J, H_J	–	HV line is 1 km long
Location factor of adjacent structure		None	C_{DJ}	–	Table A.1
Withstand voltage of internal system (kV)			U_W	2,5	
Number of conductors		3 phase conductors + neutral	n_P	4	Table B.7
		Resulting parameter	P_{LD}	1	Table B.11 and Table B.12
Lateral distance for S2 (m)			r_{MP}	140	$350/U_{WP}$, see Equation (A.8)
Lateral distance for S4 (m)			r_{IP}	384	$2\,000/U_{WP}{}^{1.8}$, see Equation (A.12)

F.4.2 Calculation of expected annual number of dangerous events

The results of calculations are given in Table F.27 for the collection areas and in Table F.28 for the expected number of dangerous events.

Table F.27 – Hospital: collection areas of structure and power line

	Symbol	Result m²	Reference Equation
Structure	A_D	$2,23 \times 10^4$	Equation (A.3)
	A_M	$1,18 \times 10^5$	Equation (A.8)
Power line	A_{LP1}	$4,00 \times 10^4$	Equation (A.10)
	A_{IP1}	$7,69 \times 10^5$	Equation (A.12)
	A_{LP2}	$2,00 \times 10^3$	Equation (A.10)
	A_{IP2}	$3,84 \times 10^4$	Equation (A.12)

Table F.28 – Hospital: expected annual number of dangerous events

	Symbol	Result 1/year	Reference Equation
Structure	N_D	$1,79 \times 10^{-1}$	Equation (A.5)
	N_M	$4,70 \times 10^{-1}$	Equation (A.7)
Power line	N_{LP1}	$9,6 \times 10^{-3}$	Equation (A.9)
	N_{IP1}	$9,23 \times 10^{-2}$	Equation (A.11)
	N_{LP2}	$2,4 \times 10^{-3}$	Equation (A.9)
	N_{IP2}	$2,31 \times 10^{-2}$	Equation (A.11)
	N_{LP}	$1,2 \times 10^{-2}$	
	N_{IP}	$1,15 \times 10^{-1}$	

F.4.3 Risk management

As a first step, the zones in which the structure can be divided should be identified. For each zone, both the risk R and the frequency of damage F to internal systems are assessed.

This implies:

a) the need to determine the risk R and to compare it with the tolerable risk $R_T = 10^{-5}$ (7.3). If necessary, suitable protection measures to mitigate such risk will be selected. Risk components will be evaluated according to Table 3;

b) the need to determine the frequency of damage F and to compare it with the required tolerable risk F_T (9.3). In this case, based on evaluations relevant to the quality of the service provided by the hospital, the tolerable frequency of damage was fixed by the General Manager of the hospital to the value $F_T = 10^{-2}$ for the operating block and the intensive care unit and $F_T = 5 \times 10^{-2}$ for the rooms block. If necessary, suitable protection measures to reduce such frequency of damage will be selected. Frequency of damage components will be evaluated according to 9.2.

F.4.4 Definition of zones in the hospital

The following zones are defined as follows:

Z_1 (entrance area outside);

Z_2 (roof);

Z_3 (rooms block);

Z_4 (operating block);

Z_5 (intensive care unit);

taking into account the following:

– the surface type is different from the inside to the outside;

– two separate fireproof compartments exist: the first is the rooms block (Z_3) and the second is the operating block together with the intensive care unit (Z_4 and Z_5);

– in all inner zones Z_3, Z_4 and Z_5, internal systems connected to the power line exist;

– no spatial shields exist;

- the intensive care unit contains extensive sensitive electronic systems and a spatial shield can be adopted as a protection measure;
- people in the two outside zones, Z_1 and Z_2, are protected by the structure or its external LPS from a direct strike and therefore in this example it is not necessary to calculate R_B for these zones;
- people in the two outside zones, Z_1 and Z_2, are not protected from step and touch voltages caused by a direct strike to the structure and therefore it is necessary to calculate R_{AT} for these zones.

The use of values less than 1 for r_p has been selected in agreement with the building owner, see Clause B.4.

The values of the time of annual attendance of persons in each zone and the risk components to be considered are shown in Table F.29.

Table F.29 – Hospital: time of presence of persons and risk components in zones

Zone	Time of presence hours/year	Risk components								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_1 (entrance outside)	175	X								
Z_2 (roof)	90	X	X				X			
Z_3 (room block)	8 760	X		X	X	X	X	X	X	X
Z_4 (operating block)	3 100	X		X	X	X	X	X	X	X
Z_5 (intensive care unit)	8 760	X		X	X	X	X	X	X	X

The defined parameters for the zones Z_1 to Z_5 are given in Table F.30 to Table F.34.

Table F.30 – Hospital: factors valid for zone Z_1 (outside the building)

Input parameter	Comment	Symbol	Value	Reference
Ground surface	Concrete	r_t	10^{-2}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	None	r_f	-	Table B.6
Fire protection	None	r_p	-	Table B.5
Factor for persons in zone	t_z/8 760 = 175/8 760	P_P	0,02	Equation (B.14)
Factor for equipment in zone	Not applicable	P_e	-	Equation (B.15)
Zone shielding	None	K_{S2}	-	Equation (B.9)
Internal wiring (Power line)	No internal systems	K_{S3P}	-	Table B.10
Internal wiring (Telecom line)	No internal systems	K_{S3T}	-	
Type of zone according to loss	Low loss zone	-	-	Table C.2

Input parameter	Comment	Symbol	Value	Reference
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	Table C.2
	Persons injured by fire	L_{F1}	-	
	Physical damage due to fire	L_{F2}	-	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	-	

Table F.31 – Hospital: factors valid for zone Z_2 (roof)

Input parameter	Comment	Symbol	Value	Reference
Ground surface	Asphalt	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Maintenance team present in the exposed area	P_o	1	Clause B.3
Risk of fire	None	r_f	0	Table B.6
Fire protection	None	r_p	-	Table B.5
Factor for persons in zone	t_z/8 760 = 90/8 760	P_P	0,01	Equation (B.14)
Factor for equipment in zone	Not applicable	P_e	-	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	-	Table B.7
SPD system (Telecom line)	None	P_{SPD}	-	Table B.8
Zone shielding	None	K_{S2}	-	Equation (B.9)
Internal wiring (Power line)	not applicable	K_{S3P}	-	Table B.10
Internal wiring (Telecom line)	No internal systems	K_{S3T}	-	
Type of zone according to loss	Low loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	10^{-1}	Table C.2
	Persons injured by fire	L_{F1}	-	
	Physical damage due to fire	L_{F2}	-	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	Table B.2
	Frequency of damage	F_T	-	Table B.1

Table F.32 – Hospital: factors valid for zone Z_3 (rooms)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	Ordinary	r_f	10^{-2}	Table B.6
Fire protection	Automatic alarm	r_p	0,2	Table B.5
Factor for persons in zone	t_z/8 760 = 8 760/8 760	P_P	1	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same conduit)	K_{S3P}	0,2	Table B.10
Internal wiring (Telecom line)	Metal free fibre optical cables	K_{S3T}	-	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	Not applicable			
Type of zone according to loss	High loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	Table C.2
	Persons injured by fire	L_{F1}	10^{-1}	
	Physical damage due to fire	L_{F2}	10^{-1}	
	Persons injured by failure of internal systems	L_O	10^{-3}	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	5×10^{-2}	

Table F.33 – Hospital: factors valid for zone Z_4 (operating block)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	Low	r_f	10^{-3}	Table B.6
Fire protection	Automatic alarm installations	r_p	0,2	Table B.5
Factor for persons in zone	t_z/8 760 = 3 100/8 760	P_P	0,35	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	-	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same cable)	K_{S3P}	0,01	Table B.10
Internal wiring (Telecom line)	Metal free fibre optical cables	K_{S3T}	-	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	Not applicable			
Type of zone according to loss	Very high loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	Table C.2
	Persons injured by fire	L_{F1}	2×10^{-1}	
	Physical damage due to fire	L_{F2}	2×10^{-1}	
	Persons injured by failure of internal systems	L_O	10^{-2}	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	10^{-2}	

Table F.34 – Hospital: factors valid for zone Z_5 (intensive care unit)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	Low	r_f	10^{-3}	Table B.6
Fire protection	Automatic alarm installations	r_p	0,2	Table B.5
Factor for persons in zone	t_z/8 760 = 8 760/8 760	P_P	1	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same cable)	K_{S3P}	0,01	Table B.10
Internal wiring (Telecom line)	Metal free fibre optical cables	K_{S3T}	-	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	Not applicable			
Type of zone according to loss	Very high loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	Table C.2
	Persons injured by fire	L_{F1}	2×10^{-1}	
	Physical damage due to fire	L_{F2}	2×10^{-1}	
	Persons injured by failure of internal systems	L_O	10^{-2}	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	10^{-2}	

F.4.5 Risk assessment

The risk R can be expressed according to Equation (1). Involved components are given in Table F.29 and risk values are given in Table F.35.

Table F.35 – Hospital: risk for the unprotected structure (values × 10^{-5})

Symbol	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,036	≈ 0	0,002	0,001	0,002
R_{AD}	-	18,357	-	-	-
R_B	-	-	3,572	0,484	0,714
R_C	-	-	17,862	63,213	178,619
R_M	-	-	1,881	0,017	0,047
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,480	0,065	0,096
R_W	-	-	1,200	4,247	12,000
R_Z	-	-	11,531	40,807	115,308
R	0,036	18,357	36,528	108,834	306,787
R_T	1				

Because in zones Z_2, Z_3, Z_4 and Z_5, R is higher than the tolerable value $R_T = 10^{-5}$, lightning protection for the structure is required to mitigate the risk in such zones.

F.4.6 Frequency of damage assessment

The frequency of damage F can be expressed according to Equation (12). Frequency components are to be evaluated according to 9.2. Involved components and total frequency evaluation are given in Table F.36.

Table F.36 – Hospital: frequency of damage for the unprotected structure

Symbol	Z_3	Z_4	Z_5
F_C	0,179	0,179	0,179
F_M	0,019	≈ 0	≈ 0
F_W	0,012	0,012	0,012
F_Z	0,115	0,115	0,115
F	0,325	0,306	0,306
F_T	0,05	0,01	0,01

NOTE No values are shown for zone Z_2 as Table F.31 states that there is no equipment in zone Z_2.

The following consideration can be made on the basis of Table F.36: because in all zones where internal systems are installed, F is higher than the tolerable values F_T, surge protection of equipment in the structure is required to reduce the frequency of damage.

F.4.7 Risk – Selection of protection measures

According to Table F.35, the zones at a higher risk are generally zones:

– Z_5 (intensive care unit);

– Z_4 (operating block), because of the high value R_C of failures of internal systems (risk

High values of risk are also reported in zones:

- Z_3 (room block), because of the high value of attendance of people in the zone (risk components R_B, R_C and R_Z);
- Z_2 (roof) because of the high probability of a direct lightning flash to people standing in the exposed area (risk component R_{AD}).

These dominant risk components can be reduced by:

a) providing the building with a warning notice which prohibits maintenance personnel from going on the roof during thunderstorms, thus reducing the risk component R_{AD} (P_{am} = 0,1 for zone Z_2);

b) providing the whole building (including the exposed areas on the roof) with an LPS class II conforming to IEC 62305-3, reducing components R_{AD} and R_B via probability P_{LPS} = 0,05. For the equipotential bonding, the LPS is equipped with SPDs installed on the power line, at the entrance of the line in the structure (LPL II). The mandatory lightning equipotential bonding reduces also the components R_U and R_V via probability P_{EB} = 0,02;

c) providing zones Z_3, Z_4 and Z_5 with a coordinated SPD system protection conforming to IEC 62305-4 for the internal power system. This will reduce the components R_C, R_M, R_W and R_Z via the probability P_{SPD}.

- Zone Z_3: LPL I, P_{SPD} = 0,01;
- Zone Z_4: better than LPL I, P_{SPD} = 0,002;
- Zone Z_5: better than LPL I, P_{SPD} = 0,002.

Using this solution, the risk values from Table F.35 will change to the reduced values reported in Table F.37.

Table F.37 – Hospital: risk for the protected structure (values × 10^{-5})

Symbol	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,002	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	0,092	-	-	-
R_B	-	-	0,357	0,048	0,071
R_C	-	-	0,179	0,126	0,357
R_M	-	-	0,019	≈ 0	≈ 0
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,010	0,001	0,002
R_W	-	-	0,012	0,008	0,024
R_Z	-	-	0,115	0,082	0,231
R	0,002	0,092	0,692	0,266	0,685
R_T	1				

F.4.8 Frequency of damage – Selection of protection measures

To reduce the frequency of damage F to the required value F_T, a suitable measure is to install a coordinated SPD system to protect internal systems connected to the power line.

According to Table F.38, the solution to be used to reduce the risk R is also valid to reduce the frequency of damage. A coordinated SPD system to protect internal systems connected to the power line is suitable.

Such an SPD system reduces the value of P_{SPD} in the zone Z_3 from 1 to 0,01, and in zones Z_4 and Z_5 from 1 to 0,002. The new values of frequency of damage components are shown in Table F.38.

Table F.38 – Hospital: frequency of damage for the protected structure

Symbol	Z_3	Z_4	Z_5
F_C	0,001 8	0,000 4	0,000 4
F_M	0,000 2	≈ 0	≈ 0
F_W	0,000 1	≈ 0	≈ 0
F_Z	0,001 1	0,000 2	0,000 2
F	0,003 2	0,000 6	0,000 6
F_T	0,05	0,01	0,01
NOTE For this table, 4 digits are used due to very small values.			

F.4.9 Conclusions

Both risk R and frequency of damage F can be reduced below the tolerable level by installing:

– a warning notice which prohibits the maintenance personnel from going on the roof during thunderstorms,

– an LPS class II for protection of the building and of the exposed areas on the roof, including equipotential bonding for the incoming power line for LPL II,

– a coordinated SPD system for power systems in all zones.

NOTE As indicated in Clause B.4, the fire alarm has been taken into account in the risk calculation because it was protected against overvoltages and other damages and firefighters were able to arrive in less than 10 min.

S12298Text Modification

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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PROTECTION CONTRE LA FOUDRE –

Partie 2: Évaluation des risques

AVANT-PROPOS

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L'IEC 62305-2 a été établie par le comité d'études 81 de l'IEC: Protection contre la foudre. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2010. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) adoption du concept de risque unique, afin de combiner les pertes de vies humaines et les pertes dues à un incendie;
b) adoption du concept de fréquence des dommages qui peuvent influencer la disponibilité des réseaux internes à la structure;
c) adoption de la densité de points d'impact au sol de la foudre N_{SG} en remplacement de la densité des coups de foudre N_G dans l'évaluation du nombre moyen annuel d'événements dangereux prévisibles;
d) la réduction de quelques composantes de risque peut être obtenue par l'utilisation de mesures préventives temporaires activées par un système d'alerte aux orages (TWS) conforme à l'IEC 62793. Le risque que des personnes soient directement frappées par la foudre dans des espaces ouverts a été décrit, en tenant compte de la réduction de ce risque au moyen d'un TWS.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
81/769/FDIS	81/772/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

La version française de la norme n'a pas été soumise au vote.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Une liste de toutes les parties de la série IEC 62305, publiées sous le titre général *Protection contre la foudre*, se trouve sur le site web de l'IEC.

Les différentes pratiques suivantes, à caractère moins permanent, existent dans les pays indiqués ci-après.

En Allemagne, la valeur de r_p = 1 s'applique dans tous les cas. Pour les composantes de risque R_B, R_C, R_M, R_V, R_W et R_Z, il est admis par hypothèse que P_{TWS} = 1. Pour LF1 et LF2, il convient d'utiliser les valeurs les plus élevées indiquées dans le Tableau C.2.

En Grèce, la valeur de P_{TWS} = 1 est admise par hypothèse pour tous les cas.

En Italie, il est exigé de calculer le risque de perte de vies humaines, RL1 dans l'Équation (7), et le risque de perte due à des dommages physiques, RL2 dans l'Équation (8), puis de comparer chaque risque au risque tolérable. La protection est assurée lorsque les deux risques, RL1 et RL2, sont inférieurs à la valeur tolérable.

Aux Pays-Bas et en Afrique du Sud, il convient de ne pas appliquer l'Annexe D et l'Annexe E pour les études courantes.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

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IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de ce document indique qu'il contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer ce document en utilisant une imprimante couleur.

INTRODUCTION

Les coups de foudre à la terre peuvent être dangereux pour les structures et les lignes qui alimentent la structure.

Ces dangers peuvent donner lieu:

- à des dommages qui altèrent la structure et son contenu;
- à des défaillances des réseaux de puissance et de communication associés;
- à des blessures sur des êtres vivants dans la structure ou à proximité de celle-ci.

Les effets consécutifs à des dommages et à des défaillances peuvent s'étendre à la proximité immédiate de la structure ou peuvent impliquer son environnement. De plus, indépendamment de l'étendue des pertes, la disponibilité de la structure et de ses réseaux internes peut être altérée de manière inacceptable si la fréquence des dommages est élevée.

Des mesures de protection peuvent être exigées pour réduire la fréquence des dommages et les pertes dues à la foudre. Il convient de déterminer la nécessité d'une telle protection et dans quelle mesure, selon la fréquence des dommages et l'appréciation du risque.

NOTE 1 La décision de mise en œuvre d'une protection contre la foudre peut être prise sans tenir compte du résultat de l'appréciation du risque ou de la fréquence des dommages lorsque le risque zéro est recherché.

NOTE 2 L'IEC 60364-4-44 [1] [1] exige systématiquement l'installation d'un dispositif de protection contre les surtensions (SPD, *Surge Protective Device*) au point d'entrée de l'alimentation électrique de la structure si les conséquences de surtensions ont une incidence sur:

- la préservation des vies humaines, par exemple services de sécurité, installations de soins médicaux;
- les services publics et le patrimoine culturel, par exemple la perte de services publics, de centres informatiques, de musées;
- les activités commerciales ou industrielles, par exemple hôtels, banques, industries, centres commerciaux, fermes.

La fréquence des dommages, définie dans le présent document comme le nombre annuel de dommages dans une structure dus aux impacts de foudre, dépend:

- du nombre annuel d'impacts de foudre qui impliquent la structure;
- de la probabilité d'événements dommageables dus à l'un de ces impacts de foudre.

Le risque, défini dans le présent document comme les pertes annuelles moyennes probables dans une structure dues aux impacts de foudre, dépend:

- de la fréquence des dommages;
- de l'étendue moyenne des pertes consécutives.

Les impacts de foudre qui impliquent une structure peuvent être divisés en:

- impacts directs sur la structure;
- impacts à proximité de la structure, directement sur les lignes connectées (lignes de puissance, de communication) ou à proximité de celles-ci.

Les impacts directs sur la structure ou une ligne connectée peuvent entraîner des dommages physiques et mettre en danger la vie des personnes. Les impacts à proximité de la structure ou d'une ligne, comme les impacts directs sur la structure ou une ligne, peuvent entraîner des défaillances des réseaux de puissance et de communication en raison des surtensions dues à un couplage résistif ou inductif entre ces réseaux et le courant de foudre.

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En outre, les défaillances dues aux surtensions de foudre dans les installations des utilisateurs et dans les lignes d'alimentation peuvent également générer des surtensions de manœuvre dans les installations.

NOTE 3 Le dysfonctionnement des réseaux de puissance et de communication n'est pas couvert par la série IEC 62305. Il est fait référence à l'IEC 61000-4-5 [2].

Le nombre d'impacts de foudre qui impliquent la structure dépend des dimensions, des caractéristiques de la structure et des lignes connectées, des caractéristiques de l'environnement de la structure et des lignes, ainsi que de la densité des points d'impact au sol de la foudre à l'emplacement de la structure et des lignes. Des recommandations sur l'évaluation du nombre d'impacts de foudre qui impliquent la structure sont données à l'Annexe A.

La probabilité de dommages dépend de la structure, de la résistivité du matériel situé sur la structure, des lignes connectées et des caractéristiques du courant de foudre, ainsi que du type et de l'efficacité des mesures de protection appliquées. Des recommandations sur l'évaluation de la probabilité de dommages dus à la foudre sont données à l'Annexe B.

L'étendue moyenne annuelle des pertes consécutives dépend de l'étendue des dommages et des effets consécutifs qui peuvent être dus à un impact de foudre. Des recommandations sur l'évaluation des pertes consécutives sont données à l'Annexe C.

L'effet des mesures de protection résulte des caractéristiques de chacune d'elles et peut réduire les probabilités de dommages.

NOTE 4 Il est admis par hypothèse que les dispositifs de protection sont mis en œuvre selon la qualité nécessaire.

Les mesures de protection sont destinées à être conformes à la série IEC 62305, à la série IEC 61643 et à l'IEC 62793, selon le cas.

NOTE 5 Pour les structures complexes (telles que les usines pétrochimiques, les grandes installations industrielles), les facteurs mentionnés dans les annexes du présent document peuvent exiger une évaluation plus approfondie des caractéristiques de la structure.

Les réglementations nationales ou locales peuvent fournir des recommandations ou des exigences minimales pour l'application du présent document. Il s'agit notamment de fixer les valeurs de risque tolérable R_T et de la fréquence tolérable des dommages F_T, ainsi que les règles de calcul et les valeurs des paramètres indiquées à l'Annexe A, l'Annexe B, l'Annexe C et l'Annexe E.

PROTECTION CONTRE LA FOUDRE –

Partie 2: Évaluation des risques

1 Domaine d'application

La présente partie de l'IEC 62305 s'applique à l'évaluation des risques auxquels une structure est exposée en raison des coups de foudre à la terre.

Elle est destinée à proposer une procédure d'évaluation d'un tel risque. Lorsque la limite supérieure du risque tolérable est fixée, la procédure permet de choisir les mesures de protection appropriées pour réduire le risque à une valeur inférieure ou égale à la valeur limite tolérable.

L'évaluation des risques comprend également l'évaluation de la fréquence des dommages causés aux réseaux internes par les chocs dus aux coups de foudre à la terre. Lorsque la limite supérieure tolérable de la fréquence des dommages est fixée, la procédure permet de choisir les mesures de protection appropriées pour réduire la fréquence des dommages à une valeur inférieure ou égale à la valeur limite tolérable.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 61643 (toutes les parties), *Parafoudres basse tension*

IEC 62305-1:2024, *Protection contre la foudre – Partie 1: Principes généraux*

IEC 62305-3:2024, *Protection contre la foudre – Partie 3: Dommages physiques sur les structures et risques humains*

IEC 62305-4:2024, *Protection contre la foudre – Partie 4: Réseaux de puissance et de communication dans les structures*

IEC 62793, *Systèmes d'alerte aux orages – Protection contre la foudre*

IEC 62858, *Densité de foudroiement basée sur des systèmes de localisation de la foudre – Principes généraux*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/

3.1
structure à protéger
tout endroit, installation ou bâtiment susceptible de contenir des personnes, des animaux, des matériaux ou des systèmes

Note 1 à l'article: Une structure à protéger peut faire partie d'une structure de plus grandes dimensions.

3.2
structure qui présente un risque d'explosion
structures associées qui comportent des zones dangereuses comme cela est déterminé conformément à l'IEC 60079-10-1 [3] et à l'IEC 60079-10-2 [4] ou des matériaux explosifs solides

Note 1 à l'article: L'IEC 60079-10-1 et l'IEC 60079-10-2 ne traitent pas des dangers liés aux explosifs solides.

3.3
structure dangereuse pour l'environnement
structure qui peut être à l'origine d'émissions biologiques, chimiques et radioactives à la suite d'un foudroiement

EXEMPLE Usines chimiques, pétrochimiques.

3.4
environnement urbain
zone qui présente une forte densité de bâtiments ou une population importante et des bâtiments élevés

EXEMPLE Centre-ville.

3.5
environnement suburbain
zone qui présente une densité moyenne de bâtiments

EXEMPLE Zones à la périphérie immédiate des villes, communautés résidentielles.

3.6
environnement rural
zone qui présente une faible densité de bâtiments

EXEMPLE Campagne.

3.7
tension assignée de tenue aux chocs
U_W
valeur de tension assignée de tenue aux chocs fixée par le fabricant aux matériels ou à une partie d'entre eux, caractérisant la capacité de tenue spécifiée de son isolation contre des surtensions

Note 1 à l'article: Pour les besoins du présent document, seule la tension de tenue entre les conducteurs actifs et la terre est prise en compte.

[SOURCE: IEC 60664-1:2020, 3.1.18 [5], modifié – Le symbole U_{imp} a été remplacé par U_w, dans la définition "surtensions transitoires" a été remplacé par "tensions" et la Note à l'article a été ajoutée.]

3.8
réseau de puissance
réseau qui comprend des composants de l'alimentation basse tension

3.9
réseau de communication
réseau qui comprend des composants électroniques sensibles tels que le matériel de communication, les systèmes informatiques, de commande et d'instrumentation, les systèmes radioélectriques et les installations électroniques de puissance

3.10
réseaux internes
réseaux de puissance et de communication d'une structure

3.11
ligne
ligne de puissance ou de communication connectée à la structure à protéger

3.12
ligne de communication
ligne prévue pour la communication entre des matériels qui peuvent être situés dans des structures distinctes

EXEMPLE Lignes téléphoniques, lignes de données.

3.13
ligne de puissance
ligne de distribution alimentant en énergie électrique les équipements électriques et électroniques d'une structure

EXEMPLE Réseaux électriques basse tension (BT) ou haute tension (HT).

3.14
événement dangereux
impact de foudre direct ou à proximité de la structure à protéger, ou direct ou à proximité d'une ligne connectée à la structure à protéger, susceptible de provoquer des dommages

3.15
impact de foudre sur une structure
coup de foudre qui frappe une structure à protéger

3.16
impact de foudre à proximité d'une structure
coup de foudre qui frappe suffisamment près d'une structure à protéger pour pouvoir causer des surtensions dangereuses

3.17
impact de foudre sur une ligne
coup de foudre qui frappe une ligne connectée à la structure à protéger

3.18
impact de foudre à proximité d'une ligne
coup de foudre qui frappe suffisamment près d'une ligne connectée à la structure à protéger pour pouvoir causer des surtensions dangereuses

3.19
densité de foudroiement au sol
N_G
nombre moyen d'éclairs nuage-sol par unité de surface et par unité de temps (éclairs × km^{-2} × an^{-1})

Note 1 à l'article: Les coups de foudre au sol peuvent avoir plusieurs points d'impact au sol

3.20
densité de points d'impact au sol de la foudre
N_{SG}
nombre moyen de points d'impact au sol ou sur des objets situés au sol, par unité de surface et par unité de temps (points d'impact × km^{-2} × an^{-1})

3.21
fréquence des événements dangereux dus aux impacts sur une structure
N_D
nombre annuel moyen prévisible des événements dangereux dus aux impacts de foudre sur une structure

3.22
fréquence des événements dangereux dus aux impacts sur une ligne
N_L
nombre annuel moyen prévisible des événements dangereux dus aux impacts de foudre sur une ligne

3.23
fréquence des événements dangereux dus aux impacts à proximité d'une structure
N_M
nombre annuel moyen prévisible des événements dangereux dus aux impacts de foudre à proximité d'une structure

3.24
fréquence des événements dangereux dus aux impacts à proximité d'une ligne
N_I
nombre annuel moyen prévisible des événements dangereux dus aux impacts de foudre à proximité d'une ligne

3.25
impulsion électromagnétique de foudre
IEMF
champ électromagnétique qui varie rapidement dans le temps, qui est émis par la foudre et qui crée des chocs par couplage résistif, inductif, capacitif et électromagnétique aux circuits

3.26
choc
onde transitoire qui crée une surtension ou une surintensité, due aux impulsions électromagnétiques de foudre (IEMF) couplées aux lignes et aux matériels

3.27
nœud
point d'une ligne où la propagation d'un choc peut être négligée

EXEMPLE Une sous-station HT pour une ligne de puissance, ou un central de communications pour une ligne de communication.

3.28
dommages physiques
dommage subi par une structure (ou son contenu) en raison des effets mécaniques, thermiques, chimiques et explosifs de la foudre

3.29
blessures sur des êtres humains
blessures, y compris la mort, de personnes causées par la foudre

3.30
défaillance des réseaux internes
dommage des réseaux de puissance et de communication dû aux impulsions électromagnétiques de foudre (IEMF)

3.31
probabilité de dommages
P
probabilité qu'un événement dangereux entraîne des dommages dans la zone concernée ou au système interne de la structure à protéger

3.32
fréquence des dommages
F
valeur du nombre annuel d'événements qui provoquent des dommages et qui sont susceptibles de se produire sur les réseaux internes à la structure à protéger

3.33
composante de fréquence des dommages
F_{X}
fréquence partielle des dommages, qui dépend de la source des dommages

3.34
fréquence tolérable des dommages
F_{T}
valeur maximale de la fréquence des dommages qui peut être tolérée par les matériels dans la structure ou dans une zone à protéger

3.35
pertes
L_{X}
étendue moyenne d'un type spécifié de dommage consécutif à un événement dangereux, dans la zone concernée d'une structure

3.36
service
fonction réalisée par les réseaux internes à la structure afin de répondre à un besoin spécifique

3.37
risque
R
perte moyenne annuelle probable due à la foudre, subie par une structure ou une zone spécifique de la structure

3.38
composante de risque
R_{X}
risque partiel qui dépend de la source et du type de dommage

3.39
risque tolérable
R_{T}
valeur maximale du risque qui peut être tolérée pour la structure à protéger

3.40
zone à risque
Z_X
<d'une structure> partie d'une structure dont les caractéristiques sont homogènes et dans laquelle un seul jeu de paramètres est applicable à l'appréciation du risque

Note 1 à l'article: Une structure peut contenir une ou plusieurs zones.

3.41
section d'une ligne
S_L
partie d'une ligne dont les caractéristiques sont homogènes et pour laquelle un seul jeu de paramètres est utilisé dans l'évaluation d'une composante du risque ou de la fréquence des dommages

3.42
zone de protection contre la foudre
ZPF
zone dont l'environnement électromagnétique est défini

Note 1 à l'article: Les frontières d'une ZPF ne sont pas nécessairement physiques.

3.43
niveau de protection contre la foudre
NPF
chiffre lié à un ensemble de paramètres du courant de foudre et relatif à la probabilité que les valeurs de conception associées maximales et minimales ne soient pas dépassées lorsque la foudre apparaît de manière naturelle

Note 1 à l'article: Un niveau de protection contre la foudre est utilisé pour prévoir des mesures de protection conformément à l'ensemble approprié de paramètres du courant de foudre.

3.44
mesures de protection
mesures adoptées dans la structure à protéger pour réduire le risque ou la fréquence des dommages

3.45
protection contre la foudre
PCLF
mesures prises pour protéger des structures contre les effets de la foudre, y compris leurs réseaux internes, leur contenu et les personnes qui s'y trouvent, qui comprennent généralement un SPF et une MPF

Note 1 à l'article: Il est également admis de faire appel à des mesures de protection auxiliaires telles qu'un système d'alerte aux orages (TWS).

3.46
système de protection contre la foudre
SPF
système complet utilisé pour réduire les dangers de blessures sur des êtres vivants et de dommages physiques dus aux coups de foudre sur une structure

Note 1 à l'article: Un système de protection contre la foudre comprend à la fois un système de protection contre la foudre d'extérieur et un système de protection contre la foudre d'intérieur.

3.47
mesures de protection contre la foudre
MPF
mesures prises pour protéger les réseaux internes contre les effets de l'IEMF

Note 1 à l'article: Les mesures de protection contre les chocs font partie d'une protection globale contre la foudre.

3.48
blindage électromagnétique
écran en matériau conducteur destiné à réduire la pénétration d'un champ électromagnétique qui varie dans le temps dans la structure à protéger, ou une partie de celle-ci, afin de réduire les défaillances des réseaux internes

3.49
câble de protection contre la foudre
câble spécial avec une tension assignée de tenue aux chocs U_{w} supérieure à U_{w} du matériel connecté et qui dispose d'une gaine métallique en contact permanent avec le sol, que ce soit de manière directe ou par l'intermédiaire d'un revêtement plastique conducteur

3.50
conduit de protection contre la foudre
conduit de faible résistivité en contact avec le sol

EXEMPLE Conduits en béton armé avec connexion aux structures métalliques internes, conduits métalliques.

3.51
dispositif de protection contre les surtensions
parafoudre
SPD
dispositif incluant au moins un composant non linéaire destiné à limiter les surtensions transitoires et à écouler les courants de foudre

Note 1 à l'article: L'abréviation "SPD" est dérivée du terme anglais développé correspondant "surge protective device".

[SOURCE: IEC 61643-11:2011, 3.1.1 [6], modifié – Le terme "surtensions" a été remplacé par "surtensions transitoires" et la Note a été supprimée.]

3.52
système de protection par parafoudres coordonnés
système composé de parafoudres choisis, coordonnés et mis en œuvre de manière appropriée afin de constituer un réseau destiné à réduire les défaillances des réseaux de puissance et de communication

3.53
interface d'isolement
dispositif capable de réduire les chocs conduits sur une ligne qui pénètre dans la zone de protection contre la foudre (ZPF)

Note 1 à l'article: L'interface d'isolement comprend des transformateurs d'isolement à écran mis à la terre entre les enroulements, les câbles fibroniques non métalliques et les optoisolateurs.

Note 2 à l'article: Les caractéristiques de tenue d'isolement de ce dispositif adaptées à cette application sont fournies de manière intrinsèque ou par l'intermédiaire d'un parafoudre.

3.54
liaison équipotentielle de foudre
EB
interconnexion des parties métalliques d'un SPF, par des connexions directes ou par des parafoudres réduisant les différences de potentiel engendrées par le courant de foudre

Note 1 à l'article: L'abréviation "EB" est dérivée du terme anglais développé correspondant "equipotential bonding".

3.55
système d'alerte aux orages
TWS
système composé d'un ou de plusieurs détecteurs d'orage capables de surveiller l'activité orageuse ou l'activité orageuse à venir dans la zone de surveillance (MA) et d'outils qui permettent de traiter les données acquises pour déclencher une alarme (alerte) valide en cas de phénomène de foudre (LRE) ou de conditions de foudre (LRC) pour une zone environnante (SA) définie

Note 1 à l'article: Dans certains pays, les TWS sont appelés "systèmes d'alerte à la foudre".

Note 2 à l'article: L'abréviation "TWS" est dérivée du terme anglais développé correspondant "thunderstorm warning system".

[SOURCE: IEC 62793:2020, 3.1.23]

3.56
phénomène de foudre
LRE
phénomène où un ou plusieurs éclairs nuage-sol (CG) surviennent à l'intérieur de la zone environnante (SA)

Note 1 à l'article: L'abréviation "LRE" est dérivée du terme anglais développé correspondant "lightning-related event".

[SOURCE: IEC 62793:2020, 3.1.15]

3.57
conditions de foudre
LRC
champ électrique statique qui a atteint un niveau suffisamment élevé pour s'attendre à la survenue d'un éclair à tout moment dans la zone environnante (SA)

Note 1 à l'article: L'abréviation "LRC" est dérivée du terme anglais développé correspondant "lightning-related conditions".

[SOURCE: IEC 62793:2020, 3.1.16]

3.58
zone de surveillance
MA
zone géographique dans laquelle l'activité orageuse ou l'activité orageuse à venir (la survenue d'un éclair est attendue à tout moment) est surveillée afin de produire des alertes valides pour la zone environnante (SA)

Note 1 à l'article: La zone de surveillance est de taille inférieure ou égale à la zone de couverture.

Note 2 à l'article: L'abréviation "MA" est dérivée du terme anglais développé correspondant "monitoring area".

[SOURCE: IEC 62793:2020, 3.1.18]

3.59
zone environnante
SA
zone géographique dans laquelle un phénomène de foudre (LRE) occasionne un danger potentiel et qui entoure et inclut la cible (TA) à protéger

Note 1 à l'article: Tout phénomène de foudre (LRE) qui survient dans la zone environnante (SA) est potentiellement dangereux pour la cible. Cette zone est utilisée lors de l'évaluation d'un système d'alerte aux orages (TWS) afin d'établir les paramètres de performance tels que le taux de défaillance d'alerte (FTWR).

Note 2 à l'article: L'abréviation "SA" est dérivée du terme anglais développé correspondant "surrounding area".

[SOURCE: IEC 62793:2020, 3.1.20]

3.60
zone 0
emplacement dans lequel une atmosphère explosive gazeuse est présente en permanence, ou pour de longues périodes ou fréquemment

Note 1 à l'article: Les termes "longues" et "fréquemment" sont destinés à décrire une très forte probabilité de présence d'une atmosphère potentiellement explosive dans l'emplacement. À cet égard, il n'est pas nécessaire de quantifier ces termes.

[SOURCE: IEC 60079-10-1:2020, 3.3.4 [3]]

3.61
zone 1
emplacement dans lequel une atmosphère explosive gazeuse est susceptible de se présenter occasionnellement en fonctionnement normal

[SOURCE: IEC 60079-10-1:2020, 3.3.5 [3]]

3.62
zone 2
emplacement dans lequel une atmosphère explosive gazeuse n'est pas susceptible de se présenter en fonctionnement normal, mais qui si c'est le cas, peut persister uniquement sur une durée courte

[SOURCE: IEC 60079-10-1:2020, 3.3.6 [3]]

3.63
zone 20
emplacement dans lequel une atmosphère explosive poussiéreuse, sous la forme de nuage de poussière dans l'air, est présente en permanence, ou pendant de longues périodes ou fréquemment

[SOURCE: IEC 60079-10-2:2015, 3.25.1 [4]]

3.64
zone 21
emplacement dans lequel une atmosphère explosive poussiéreuse, sous la forme de nuage de poussière dans l'air, est susceptible de se présenter occasionnellement, en fonctionnement normal

[SOURCE: IEC 60079-10-2:2015, 3.25.2 [4]]

3.65
zone 22
emplacement dans lequel une atmosphère explosive poussiéreuse, sous la forme de nuage de poussières combustibles dans l'air, n'est pas susceptible de se présenter en fonctionnement normal, mais peut persister uniquement pendant une courte durée

Note 1 à l'article: La possibilité de créer un nuage de poussière explosif à partir d'une couche de poussière nécessite aussi d'être prise en compte.

[SOURCE: IEC 60079-10-2:2015, 3.25.3 [4]]

3.66
structure adjacente
structure reliée à la structure soumise à l'étude par au moins une ligne

4 Symboles et abréviations

A_D	Surface équivalente d'exposition pour les impacts sur une structure isolée	A.2.1.2
A_D'	Surface d'exposition pour les toitures élevées saillantes	A.2.1.3
A_{DJ}	Surface équivalente d'exposition pour les impacts sur une structure adjacente	A.2.5
A_I	Surface équivalente d'exposition pour les impacts à proximité d'une ligne	Article A.5
A_L	Surface équivalente d'exposition pour les impacts sur une ligne	Article A.4
A_M	Surface équivalente d'exposition pour les impacts à proximité de la structure	Article A.3
B	Bâtiment	A.2.2
C_D	Facteur d'emplacement	Tableau A.1
C_{DJ}	Facteur d'emplacement d'une structure adjacente	A.2.5, Tableau A.1
C_E	Facteur d'environnement	Tableau A.4
C_I	Facteur d'installation de la ligne	Tableau A.2
C_{LD}	Facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne pour les impacts sur une ligne	Tableau B.9
C_{LI}	Facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne pour les impacts à proximité d'une ligne	Tableau B.9
C_T	Facteur de type de ligne dû à la présence d'un transformateur HT/BT sur la ligne	Tableau A.3
D_{1D}	Choc électrique qui résulte d'impacts qui frappent directement des êtres humains	5.2
D_{1T}	Choc électrique qui frappe des êtres humains à la suite d'un couplage résistif et inductif	5.2
D_2	Étincelage dangereux qui entraîne un incendie ou une explosion	5.2
D_3	Chocs dus à toutes les sources de dommages	5.2
F	Fréquence des dommages	9.1
F_C	Fréquence des dommages dus à des impacts sur la structure (source S_1)	9.1
F_M	Fréquence des dommages dus à des impacts à proximité de la structure (source S_2)	9.1

L_{M1} Pertes liées à des blessures sur des êtres humains, causées par des défaillances des réseaux internes (impacts à proximité d'une structure) .... Tableau 3, Article C.2

L_{M2} Pertes associées à des défaillances des réseaux internes (impacts à proximité d'une structure) .... Tableau 3, Article C.2

L_{O1} Rapport type moyen du nombre de personnes blessées par des défaillances des réseaux internes du fait d'un événement dangereux sur le nombre total de personnes dans la zone .... Article C.2

L_{O2} Rapport type moyen des dommages physiques causés par des défaillances des réseaux internes du fait d'un événement dangereux sur le montant maximal des dommages dans la zone .... Article C.2

L_T Rapport type moyen du nombre de personnes blessées par des tensions de contact et de pas du fait d'un événement dangereux sur le nombre total de personnes dans la zone .... Article C.2

L_{UT} Pertes liées à des blessures sur des êtres humains par choc électrique qui résulte d'un couplage résistif et inductif (impacts sur une ligne)…….. .... Article C.2

L_{V1} Pertes liées à des blessures sur des êtres humains, causées par des dommages physiques sur une structure (impacts sur une ligne) .... Article C.2

L_{V2} Pertes occasionnées à une structure, liées à des dommages physiques (impacts sur une ligne) .... Article C.2

L_{VT} Pertes totales occasionnées à une structure, liées à des dommages physiques, y compris des dommages d'environnement (impacts sur une ligne) .... Article C.2

L_{W1} Pertes liées à des blessures sur des êtres humains, causées par des défaillances des réseaux internes (impacts sur une ligne) .... Article C.2

L_{W2} Pertes associées à des défaillances des réseaux internes (impacts sur une ligne) .... Article C.2

L_X Pertes consécutives à des dommages 8.1

L_{Z1} Pertes liées à des blessures sur des êtres humains, causées par des défaillances des réseaux internes (impacts à proximité d'une ligne)............ Article C.2

L_{Z2} Pertes associées à des défaillances des réseaux internes (impacts à proximité d'une ligne)............ Article C.2

n' Nombre de conducteurs dans un câble .... Tableau B.7

n Nombre total de conducteurs de câbles et de chemins conducteurs externes .... Tableau B.7

N_D Nombre annuel d'événements dangereux dus à des impacts sur une structure…… A.2.4

N_{DJ} Nombre d'événements dangereux dus à des impacts sur une structure adjacente .. A.2.5

N_G Densité annuelle de foudroiement au sol .... Article A.1

N_I Nombre d'événements dangereux dus aux impacts à proximité d'une ligne ...... Article A.5

N_L Nombre d'événements dangereux dus aux impacts sur une ligne .... Article A.4

N_M Nombre d'événements dangereux dus aux impacts à proximité d'une structure .... Article A.3

N_{SG} Densité annuelle de points d'impact au sol de la foudre .... Article A.1

N_X Nombre annuel d'événements dangereux 8.1, 9.2

P_{AD} Probabilité qu'un impact sur une structure provoque un choc sur une personne .... Article B.3

P_{am} Probabilité qu'un impact sur une structure provoque des blessures sur des êtres humains dues à des tensions de contact et de pas .... Article B.2

P_{AT} Probabilité qu'un impact sur une structure provoque des tensions dangereuses de contact et de pas .... Article B.2

P_B Probabilité de dommages physiques sur une structure (impacts sur une structure).. Article B.4

P_C Probabilité de défaillances des réseaux internes (impacts sur une structure) ... Article B.5

P_e Probabilité qu'un matériel soit exposé à un événement dommageable .... Article B.12

P_{EB} Probabilité qu'une étincelle apparaisse entre des sections conductrices électriquement isolées, malgré une protection par liaison équipotentielle de foudre (EB) .... Article B.7, Tableau B.13

P_{LD} Probabilité de réduction de P_U, P_V et P_W en fonction des caractéristiques de la ligne et de la tension de tenue du matériel (impacts sur la ligne connectée) .... Article B.7

P_{LPS} Probabilité qui dépend du NPF du système de protection contre la foudre (SPF) .... Article B.3

P_M Probabilité de défaillances des réseaux internes (impacts à proximité d'une structure) .... Article B.6

P_{MS} Probabilité de réduction de P_M en fonction du blindage, du câblage et de la tension de tenue du matériel .... Article B.6

P_O Facteur de probabilité en fonction de la position d'une personne dans la zone exposée .... Article B.3

P_P Probabilité qu'une personne se trouve à un emplacement dangereux .... Article B.11

P_Q Probabilité que la valeur de la charge associée au courant qui traverse le parafoudre dépasse la valeur tolérée par le parafoudre................................ Annexe D

P_S Probabilité qu'un impact sur une structure provoque un étincelage dangereux . Article B.4

P_{SPD} Probabilité qu'un appareil soit endommagé malgré sa protection par un système de protection par parafoudres coordonnés........................... Tableau B.8, Tableau B.9

P_{TWS} Probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible .... Article B.1

P_U Probabilité de blessures sur des êtres humains par choc électrique (impacts sur une ligne connectée) .... Article B.7

P_{Up} Probabilité que la valeur de tension résiduelle sur un SPD dépasse le niveau de protection exigé U_p, pertinent pour le courant qui traverse le SPD……… .... Annexe D

P_V Probabilité de dommages physiques sur une structure (impacts sur une ligne connectée)........................... Article B.8

P_W Probabilité de défaillances des réseaux internes (impacts sur une ligne connectée) .... Article B.9

P_X Probabilité de dommages 8.1, 9.2

P_Z Probabilité de défaillances des réseaux internes (impacts à proximité d'une ligne connectée)........................... Article B.10

r_f Facteur de réduction de pertes associées au risque d'incendie........................ Article B.4

r_M	Distance conventionnelle	Article A.3, Article A.5
r_p	Facteur de réduction de pertes dues aux dispositions contre l'incendie	Article B.4
r_t	Facteur de réduction associé au type de surface	Article B.2
R	Risque	6.1, 6.3.1, 6.3.2
R_{AD}	Composante de risque (blessures causées par un éclair qui frappe des êtres humains exposés sur une structure – impacts sur une structure)	6.2.1, Tableau 2, Tableau 3
R_{AT}	Composante de risque (blessures sur des êtres humains causées par un choc électrique en raison de tensions de contact et de pas – impacts sur une structure)	6.2.1, Tableau 2, Tableau 3
R_B	Composante de risque (dommages physiques sur une structure – impacts sur une structure)	6.2.1, Tableau 2, Tableau 3
R_C	Composante de risque (défaillances des réseaux internes – impacts sur une structure)	6.2.1, Tableau 2, Tableau 3
R_M	Composante de risque (défaillances des réseaux internes – impacts à proximité d'une structure)	6.2.2, Tableau 2, Tableau 3
R_S	Résistance de blindage par unité de longueur d'un câble	Tableau B.12, Tableau B.13
R_T	Risque tolérable	7.3
R_U	Composante de risque (blessures sur des êtres humains – impacts sur une ligne connectée)	6.2.3, Tableau 2, Tableau 3
R_V	Composante de risque (dommages physiques sur une structure – impacts sur une ligne connectée)	6.2.3, Tableau 2, Tableau 3
R_W	Composante de risque (défaillances des réseaux internes – impacts sur une ligne connectée)	6.2.3, Tableau 2, Tableau 3
R_X	Composante de risque pour une structure	8.1
R_Z	Composante de risque (défaillances des réseaux internes – impacts à proximité d'une ligne)	6.2.4, Tableau 2, Tableau 3
S	Structure	A.2.2
S1	Source de dommages – impacts sur une structure	5.1, Tableau 3
S2	Source de dommages – impacts à proximité d'une structure	5.1, Tableau 3
S3	Source de dommages – impacts sur une ligne	5.1, Tableau 3
S4	Source de dommages – impacts à proximité d'une ligne	5.1, Tableau 3
S_L	Section d'une ligne	8.4
t_z	Temps, en heures, par année de présence de personnes à un emplacement dangereux	Article B.11
U_W	Tension de choc assignée d'un réseau	Article A.3, Article A.5, Article B.7
w_m	Largeur de maille	Article B.6
W	Largeur de structure	A.2.1.2
X	Indice générique de la composante de risque, du nombre d'événements dangereux, de la probabilité et des pertes	8.1, 9.2
Z_S	Zones d'une structure	8.3

5 Dommages et pertes

5.1 Source de dommages

Le courant de foudre est la source principale des dommages. Les détails relatifs aux courants de foudre et aux propriétés de la foudre doivent être pris en compte, conformément à l'IEC 62305-1:2024. Les sources suivantes sont distinguées en fonction de l'emplacement du point d'impact:

S1: impacts sur la structure;

S2: impacts à proximité de la structure;

S3: impacts sur une ligne connectée à la structure;

S4: impacts à proximité d'une ligne connectée à la structure.

5.2 Causes de dommages

Un impact de foudre peut entraîner des dommages qui dépendent, à plus d'un titre, des caractéristiques de la structure évaluée. Parmi les caractéristiques les plus importantes, il y a le type de construction, le contenu et ses applications, le type de service et les mesures de protection prises. Les dommages physiques sur les structures et les risques humains doivent être pris en compte, conformément à l'IEC 62305-3.

En conséquence, quatre causes de dommages peuvent être distinguées:

- D_{1D}: choc électrique qui frappe des êtres humains à la suite d'un coup de foudre;
- D_{1T}: choc électrique qui frappe des êtres humains à la suite d'un couplage résistif et inductif;
- D_2: étincelage dangereux à l'intérieur de la structure, qui déclenche un incendie ou une explosion ou provoque des effets mécaniques et chimiques, ou les deux, qui peuvent également mettre en danger l'environnement;
- D_3: chocs dus à toutes les sources de dommages qui entraînent des défaillances des réseaux internes.

Les dommages à une structure dus à la foudre peuvent être limités à une partie de la structure ou peuvent s'étendre à l'ensemble de celle-ci. Ils peuvent également concerner les structures environnantes ou l'environnement (structures dangereuses pour l'environnement).

5.3 Type de perte

Chaque type de dommage propre à une structure à protéger, qu'elle soit seule ou associée, peut entraîner différents types de pertes. Le type de perte qui peut apparaître dépend des caractéristiques de la structure elle-même.

Pour les besoins du présent document, les types de pertes suivants, qui peuvent apparaître à la suite de coups de foudre, sont envisagés:

L_1: pertes dues à des blessures sur des êtres humains. Ce type de dommage est associé aux causes D_{1D}, D_{1T}, D_2 voire D_3 dans les structures dans lesquelles une défaillance des réseaux internes met en danger la vie humaine, par exemple dans les structures avec risque d'explosion et dans les hôpitaux;

L_2: pertes dues aux dommages physiques de la structure et de son contenu. Ce type de dommage est associé aux causes D_2 et D_3 (D_3 dans les structures avec risque d'explosion, en général);

L_3: pertes dues à une défaillance des réseaux internes. Ce type de dommage est associé à la cause D_3.

NOTE 1 Les pertes L_3 ne concernent pas les dommages physiques causés à un réseau interne. Elles se concentrent sur les chocs qui altèrent la fonction assurée par le réseau interne.

Le calcul du risque s'applique à toutes les structures lorsque les types de pertes L_1 ou L_2 sont impliqués.

Le type de dommage L_3 peut altérer de manière inacceptable les services fournis par les réseaux internes de la structure. Dans ce cas, le calcul de la fréquence des dommages est effectué en complément du calcul du risque. La fréquence des dommages peut englober les pertes économiques pures ou les pertes de services. Lorsque des dommages occasionnés aux réseaux internes entraînent des conséquences pour l'environnement ou impliquent du matériel essentiel lié à la sécurité, il convient d'évaluer l'incidence des pertes par calcul du risque et non pas par le biais de la fréquence des dommages. La protection contre la foudre des réseaux de puissance et de communication dans les structures doit être prise en compte, conformément à l'IEC 62305-4:2024 et à la série IEC 61643.

NOTE 2 La perte d'un patrimoine national est traitée par les pertes L_2 et la perte d'un service public est traitée par F et par les pertes L_2/L_3.

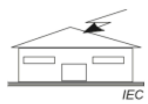
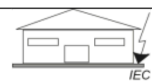
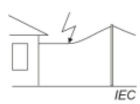
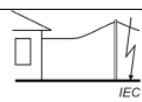
6 Risque et composantes de risque

6.1 Risque

Le risque R doit être évalué compte tenu de la sécurité des personnes (type de perte L_1) et de la structure et de son contenu (type de perte L_2).

Pour évaluer le risque R, les composantes de risque (risques partiels qui dépendent de la source de dommages et du type de perte) doivent être définies et calculées (voir le Tableau 1).

Tableau 1 – Sources de dommages, causes de dommages, types de pertes et composantes de risque en fonction du point d'impact

Point d'impact		Source de dommages	Causes de dommages	Type de perte	Composante de risque
Structure		S1	D_{1T}	L_1	R_{AT}
			D_{1D} [c]	L_1	R_{AD}
			D_2	L_1, L_2	R_{B1}, R_{B2}
			D_3	L_1[a], L_2[b]	R_{C1}, R_{C2}
À proximité de la structure		S2	D_3	L_1[a], L_2[b]	R_{M1}, R_{M2}
Lignes connectées à la structure		S3	D_{1T}	L_1	R_U
			D_2	L_1, L_2	R_{V1}, R_{V2}
			D_3	L_1[a], L_2[b]	R_{W1}, R_{W2}
À proximité des lignes connectées à la structure		S4	D_3	L_1[a], L_2[b]	R_{Z1}, R_{Z2}

Les composantes de risque de la dernière colonne sont calculées d'après le type de perte examiné (voir la colonne Type de perte).

[a] En général pour les structures dans lesquelles une défaillance des réseaux internes met en danger la vie humaine, par exemple dans les structures avec risque d'explosion et dans les hôpitaux.

[b] En général pour les structures avec risque d'explosion.

[c] Cela concerne uniquement les personnes exposées sur une structure comme un parking sur un toit ou une terrasse, un balcon.

Des exemples de calculs de risques sont fournis à l'Annexe F.

6.2 Composantes de risque

6.2.1 Composantes de risque pour une structure dû à la source S1

R_{AT}: composante liée au type de perte L_1, causé par un choc électrique qui frappe des êtres humains du fait de tensions de contact et de pas dans la structure et, à l'extérieur, dans des zones jusqu'à 3 m autour des conducteurs de descente.

R_{AD}: composante liée au type de perte L_1, causé par un éclair qui frappe des êtres humains exposés sur une structure.

R_B: composante liée aux types de pertes L_1 (R_{B1}) et L_2 (R_{B2}), causés par un étincelage dangereux dans la structure qui entraîne un incendie ou une explosion, ou qui a des répercussions mécaniques et chimiques, et qui peut également mettre en danger l'environnement.

R_C: composante liée aux types de pertes L_1 (R_{C1}) et L_2 (R_{C2}), causés par des défaillances des réseaux internes dues à l'IEMF. Des pertes peuvent généralement se produire dans le cas de structures avec risque d'explosion et dans le cas d'hôpitaux ou d'autres structures dans lesquelles les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement.

6.2.2 Composante de risque pour une structure dû à la source S2

R_M: composante liée aux types de pertes L_1 (R_{M1}) et L_2 (R_{M2}), causés par des défaillances des réseaux internes dues à l'IEMF. Des pertes peuvent se produire dans le cas de structures avec risque d'explosion et dans le cas d'hôpitaux ou d'autres structures dans lesquelles les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement.

6.2.3 Composantes de risque pour une structure dû à la source S3

R_U: composante liée au type de perte L_1, causé par un choc électrique qui frappe des êtres humains du fait des tensions de contact à l'intérieur de la structure.

R_V: composante liée aux types de pertes LL_1 (R_{V1}) et L_2 (R_{V2}),causés par un incendie ou une explosion (dus à un étincelage dangereux entre une installation extérieure et les parties métalliques généralement situées au point de pénétration de la ligne dans la structure) ou qui ont des répercussions mécaniques ou chimiques en raison du courant de foudre transmis dans les lignes entrantes.

R_W: composante liée aux types de pertes L_1 (R_{W1}) et L_2 (R_{W2}), causés par des défaillances des réseaux internes en raison des surtensions induites sur les lignes entrantes et transmises à la structure. Des pertes peuvent généralement se produire dans le cas de structures avec risque d'explosion et dans le cas d'hôpitaux ou d'autres structures dans lesquelles les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement.

NOTE 1 Toutes les lignes connectées à la structure sont prises en compte dans l'évaluation.

NOTE 2 Les impacts de foudre sur ou à proximité de canalisations métalliques sont considérés comme une source de dommages, sauf si les canalisations sont reliées à une borne d'équipotentialité ou au réseau de mise à la terre du SPF à l'entrée de la structure.

6.2.4 Composante de risque pour une structure dû à la source S4

R_Z: composante liée aux types de pertes L_1 (R_{Z1}) et L_2 (R_{Z2}), causés par des défaillances des réseaux internes en raison des surtensions induites sur les lignes entrantes et transmises à la structure. Des pertes peuvent généralement se produire dans le cas de structures avec risque d'explosion et dans le cas d'hôpitaux ou d'autres structures dans lesquelles les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement.

NOTE 1 Toutes les lignes connectées à la structure sont prises en compte dans l'évaluation.

NOTE 2 Les impacts de foudre sur ou à proximité de canalisations métalliques sont considérés comme une source de dommages, sauf si les canalisations sont reliées à une borne d'équipotentialité ou au réseau de mise à la terre du SPF à l'entrée de la structure.

6.2.5 Facteurs qui ont une incidence sur les composantes de risque pour une structure

Les caractéristiques de la structure, les mesures et dispositions prises lors d'un orage sont des facteurs qui ont une incidence sur les composantes de risque pour une structure. Les principaux facteurs sont indiqués dans le Tableau 2.

Tableau 2 – Facteurs d'influence des composantes de risque

Caractéristiques de la structure ou des réseaux internes – Mesures de protection	R_{AT}[h]	R_{AD}[h]	R_B[h]	R_C[h]	R_M	R_U	R_V	R_W	R_Z
Surface d'exposition	X	X	X	X	X	X	X	X	X
Résistivité de surface du sol	X								
Résistivité du plancher	X					X			
Restrictions physiques, isolation, panneau d'avertissement, équipotentialité du sol	X					X			
Caractéristiques de construction de la structure	X		X						
SPF	X	X	X	X	X[a]	X[b]	X[b]		
Parafoudre d'équipotentialité	X		X			X	X		
Interfaces d'isolement				X[c]	X[c]	X	X	X	X
Système de protection par parafoudres coordonnés[f]				X	X			X	X
Blindage spatial				X	X				
Lignes externes blindées						X	X	X	X
Lignes internes blindées				X	X				
Précautions de cheminement				X	X				
Réseau d'équipotentialité				X					
Précautions incendie			X				X		
Sensibilité au feu			X				X		
Tension de tenue aux chocs				X	X	X	X	X	X
Systèmes d'alerte aux orages[g]	X[d]	X[e]		X	X	X[e]	X[e]	X[e]	X[e]
Présence de personnes	X	X	X	X	X	X	X	X	X

NOTE Le matériel est généralement connecté à deux services différents, par exemple une ligne de puissance et une ligne de transmission de données. Si le matériel n'est connecté qu'à un seul service, le risque peut être surestimé dans le résultat.

[a] Uniquement pour les SPF extérieurs maillés qui servent de blindage (voir le facteur KS1 à l'Annexe B).

[b] En raison des équipotentialités.

[c] Uniquement s'ils appartiennent au matériel.

[d] Uniquement pour les zones à risque externes conformément aux dispositions activées à l'aide d'un système d'alerte aux orages (TWS) conforme à l'IEC 62793. Un TWS doit toujours être actif et fonctionnel, et il convient qu'il émette un message en cas de défaut.

[e] Conformément aux dispositions activées à l'aide d'un système d'alerte aux orages (TWS) conforme à l'IEC 62793.

[f] Principalement pour les structures dans lesquelles une défaillance des réseaux internes met en danger la vie humaine, par exemple dans les structures avec risque d'explosion et dans les hôpitaux.

[g] Les mesures prises doivent être adaptées au cas étudié.

[h] En cas de source de dommages S1, les mesures de protection ne sont efficaces qu'à l'intérieur de structures protégées par un SPF ou de structures à armature continue en métal ou en béton armé qui agit comme un SPF naturel.

6.3 Composition des composantes de risque

6.3.1 Composition des composantes de risque en fonction de la source des dommages

Le risque R est la somme de ses composantes de risque en fonction de la source de dommages ou du type de perte.

$$R = R_{S1} + R_{S2} + R_{S3} + R_{S4} \tag{1}$$

où

$$R_{S1} = R_{AT} + R_{AD} + R_{B1} + R_{B2} + R_{C1} + R_{C2} \tag{2}$$

$$R_{S2} = R_{M1} + R_{M2} \tag{3}$$

$$R_{S3} = R_{U} + R_{V1} + R_{V2} + R_{W1} + R_{W2} \tag{4}$$

$$R_{S4} = R_{Z1} + R_{Z2} \tag{5}$$

R_{C1}, R_{M1}, R_{W1} et R_{Z1} s'appliquent généralement aux structures qui présentent un risque d'explosion et aux hôpitaux équipés de matériels de réanimation électriques ou à d'autres structures, lorsque les défaillances des réseaux internes impliquent des risques de blessures humaines ou de danger pour l'environnement.

R_{C2}, R_{M2}, R_{W2} et R_{Z2} s'appliquent généralement aux structures avec risque d'explosion.

NOTE 1 Une analyse peut justifier le fait qu'un matériel endommagé par une surtension puisse engendrer un incendie ou une explosion à l'intérieur du bâtiment. Dans ce cas, les composantes de risque correspondantes peuvent également être évaluées dans le cadre de l'appréciation du risque.

NOTE 2 La valeur du risque R obtenue en ajoutant les deux composantes de risque R_M et R_Z est surestimée. Dans les réseaux de puissance internes, la composante de risque R_M est généralement négligeable. Le risque peut être évalué de manière plus exacte en tenant compte du fait qu'un impact au sol a une incidence à la fois sur les réseaux internes par couplage inductif direct et sur la surtension induite sur les lignes connectées. Il en résulte que les composantes R_M et R_Z peuvent coïncider.

6.3.2 Composition des composantes de risque en fonction du type de perte

$$R = R_{L1} + R_{L2} \tag{6}$$

où

$$R_{L1} = R_{AT} + R_{AD} + R_{B1} + R_{C1} + R_{M1} + R_{U} + R_{V1} + R_{W1} + R_{Z1} \tag{7}$$

$$R_{L2} = R_{B2} + R_{C2} + R_{M2} + R_{V2} + R_{W2} + R_{Z2} \tag{8}$$

R_{C1}, R_{M1}, R_{W1} et R_{Z1} s'appliquent généralement aux structures qui présentent un risque d'explosion et aux hôpitaux équipés de matériels de réanimation électriques ou à d'autres structures, lorsque les défaillances des réseaux internes impliquent des risques de blessures humaines ou de danger pour l'environnement.

R_{C2}, R_{M2}, R_{W2} et R_{Z2} s'appliquent principalement aux structures avec risque d'explosion.

NOTE 1 Une analyse peut justifier le fait qu'un matériel endommagé par une surtension puisse engendrer un incendie ou une explosion à l'intérieur du bâtiment. Dans ce cas, les composantes de risque correspondantes peuvent également être évaluées dans le cadre de l'appréciation du risque.

NOTE 2 La valeur du risque R obtenue en ajoutant les deux composantes de risque R_M et R_Z est surestimée. Dans les réseaux de puissance internes, la composante de risque R_M est généralement négligeable. Le risque peut être évalué de manière plus exacte en tenant compte du fait qu'un impact au sol a une incidence à la fois sur les réseaux internes par couplage inductif direct et sur la surtension induite sur les lignes connectées. Il en résulte que les composantes R_M et R_Z peuvent coïncider.

NOTE 3 Les Équations (7) et (8) permettent d'évaluer séparément la contribution du risque de perte de vies humaines et du risque de perte de biens et de services au risque global.

7 Appréciation du risque

7.1 Procédure de base

La procédure suivante doit être appliquée:

– identification de la structure à évaluer et de ses caractéristiques;
– évaluation du risque R.

7.2 Structure à prendre en compte pour l'appréciation du risque

La structure à prendre en compte comprend:

– la structure elle-même;
– les installations contenues dans la structure;
– le contenu de la structure;
– les personnes qui se trouvent dans la structure, sur le toit de la structure ou dans des zones jusqu'à 3 m de l'extérieur de la structure;
– l'environnement compromis par un dommage sur la structure.

Les lignes à l'extérieur de la structure ne sont pertinentes que dans la mesure où elles peuvent acheminer des courants susceptibles d'endommager la structure.

NOTE La structure à prendre en compte peut être subdivisée en plusieurs zones à risque (voir le 8.3).

7.3 Procédure d'évaluation du besoin de protection pour le risque *R*

La protection contre la foudre est nécessaire si le risque R est supérieur au niveau de risque tolérable R_T.

$$R > R_T$$

Dans ce cas, des mesures de protection doivent être appliquées afin de réduire le risque R à un degré qui ne dépasse pas le niveau de risque tolérable R_T.

$$R \leq R_T$$

NOTE 1 Une valeur représentative du risque tolérable est $R_T = 10^{-5}$ [année]$^{-1}$. Des valeurs différentes peuvent être attribuées après une étude approfondie, en tenant compte de la vulnérabilité des êtres humains à l'intérieur et à l'extérieur de la structure étudiée, ainsi que de la criticité de la structure et de son environnement pour le public quant aux dommages physiques.

NOTE 2 Lorsqu'une évaluation du risque n'est pas exigée par ailleurs, la décision d'évaluer la nécessité de réduire ou non le risque R peut être prise par le propriétaire ou le gérant de la structure.

NOTE 3 Si $R \leq R_T$, la protection contre la foudre n'est pas nécessaire pour réduire le risque, mais peut être:

– utile pour réduire la fréquence des dommages aux réseaux internes (voir le 9.4);

– appropriée en vue de réduire de quelque façon que ce soit les pertes (ou l'indisponibilité des services).

Les étapes suivantes doivent être suivies pour déterminer si le risque dépasse le niveau tolérable:

– identification des composantes R_X qui constituent le risque;
– calcul des composantes de risque identifiées R_X;
– calcul du risque total R (voir le 6.3);
– comparaison du risque R à la valeur tolérable R_T.

Si la structure est divisée en zones à risque Z_S (voir le 8.3), le risque R doit être évalué pour chaque zone Z_S.

Le risque R doit être comparé à R_T:

– pour chaque zone à risque de la structure dans une structure découpée en zones;
– pour l'ensemble de la structure dans une structure à une seule zone.

La Figure 1 représente la procédure d'évaluation du besoin de protection pour le risque R.

NOTE 4 En cas de source de dommages S1, les mesures de protection ne sont efficaces qu'à l'intérieur de structures protégées par un SPF ou de structures à armature continue en métal ou en béton armé qui agit comme un SPF naturel.

NOTE 5 Le propriétaire du site est informé lorsque le risque ne peut pas être réduit à un niveau tolérable, malgré la mise en œuvre des mesures de protection les plus efficaces suggérées. Si le risque peut être réduit de manière significative par des mesures préventives temporaires, un TWS conforme à l'IEC 62793 peut être installé.

Il convient de procéder à une évaluation lorsque les dommages causés à une structure par la foudre peuvent également concerner des structures environnantes ou l'environnement (propagation d'un incendie, explosion, émissions chimiques ou radioactives, par exemple).

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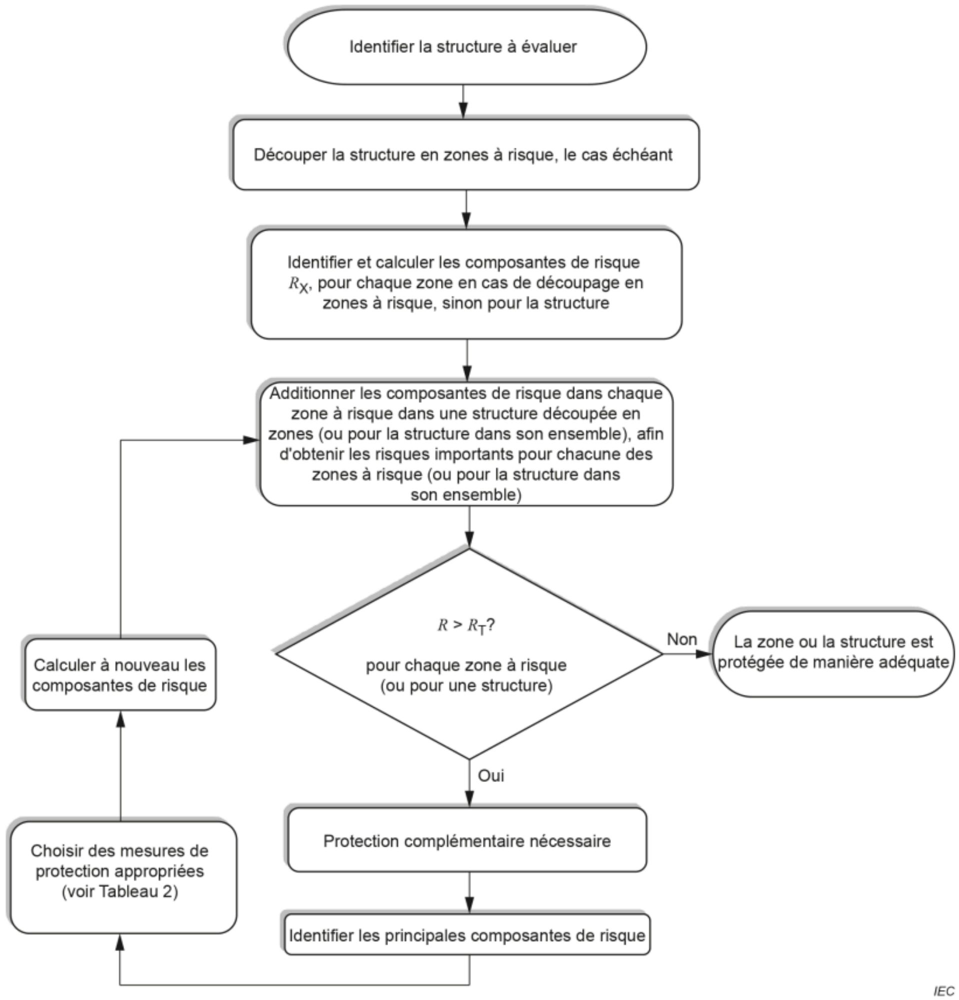

Figure 1 – Procédure de décision du besoin de protection et de choix des mesures de protection pour réduire $R \leq R_T$

8 Évaluation des composantes de risque

8.1 Équation de base

Chaque composante de risque R_{AT}, R_{AD}, R_B, R_C, R_M, R_U, R_V, R_W et R_Z, décrite dans le Tableau 3, peut être exprimée par l'équation générale suivante:

$$R_X = N_X \times P_X \times L_X \tag{9}$$

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où

N_X est le nombre annuel d'événements dangereux (voir aussi l'Annexe A);

P_X est la probabilité de dommages (voir aussi l'Annexe B);

L_X est l'étendue des pertes consécutives (voir aussi l'Annexe C).

Le nombre N_X d'événements dangereux est influencé par la densité de points d'impact au sol de la foudre (N_{SG}) et par les caractéristiques physiques de la structure à protéger, son environnement, les lignes connectées et le sol. N_X doit être obtenu, comme cela est expliqué en détail à l'Annexe A, principalement à partir des données de systèmes de localisation de la foudre (LLS, *Lightning Location System*), lesquels doivent être conformes à l'IEC 62858.

La probabilité de dommages P_X est influencée par les caractéristiques de la structure à protéger, les lignes connectées, la présence de personnes et les mesures de protection fournies.

Les pertes consécutives L_X sont influencées par l'utilisation assignée à la structure.

Si la structure est divisée en zones à risque Z_S (voir le 8.3), chaque composante de risque doit être évaluée pour chaque zone à risque Z_S.

NOTE Lorsque les dommages sur une structure dus à la foudre peuvent également impliquer des structures environnantes ou l'environnement (par exemple, émissions chimiques ou radioactives), les pertes consécutives sont ajoutées à la valeur de L_X ou le concept décrit à l'Annexe E peut être appliqué.

8.2 Évaluation des composantes de risque dû à différentes sources de dommages

Les équations pour calculer les composantes de risque liées à chaque source de dommages sont données dans le Tableau 3.

Les valeurs des paramètres nécessaires au calcul des composantes de risque figurent à l'Annexe A, l'Annexe B et l'Annexe C.

Pour l'évaluation des composantes de risque associées aux impacts de foudre sur une ligne entrante (S3), les éléments suivants doivent être pris en compte:

– si la ligne comporte plusieurs sections (voir le 8.4), les valeurs de R_U, R_V et R_W sont la somme des valeurs R_U, R_V et R_W qui correspondent à chaque section de la ligne. Les sections à prendre en compte sont celles entre la structure et le premier nœud de la distribution. Lorsqu'aucune information relative à la longueur des sections n'est disponible, une longueur de ligne maximale de 1 km pour la somme des lignes de puissance HT et des lignes de puissance BT et une longueur de ligne maximale de 1 km pour les lignes de communication peuvent être admises par hypothèse;
– dans le cas d'une structure qui comporte plusieurs lignes connectées avec des cheminements différents qui viennent alimenter le même réseau interne, les calculs doivent être effectués pour chaque ligne;
– dans le cas d'une structure qui comporte plusieurs lignes connectées avec le même cheminement qui vient alimenter le même appareil, les calculs ne doivent être réalisés que pour la ligne qui donne les valeurs N_L les plus élevées (ligne de communication ou ligne de puissance, ligne non écrantée ou ligne écrantée, ligne de puissance BT ou ligne de puissance HT avec transformateur HT/BT, etc.).

NOTE Dans le cas de lignes qui présentent un chevauchement de la surface d'exposition, la zone de chevauchement n'est prise en compte qu'une seule fois.

Pour l'évaluation des composantes de risque associées aux impacts de foudre à proximité d'une ligne connectée à la structure (S4), les éléments suivants doivent être pris en compte:

– si la ligne comporte plusieurs sections (voir le 8.4), la valeur de R_Z est la somme des composantes R_Z qui correspondent à chaque section de la ligne. Les sections à prendre en compte sont celles entre la structure et le premier nœud de la distribution. Lorsqu'aucune information relative à la longueur des sections n'est disponible, une longueur de ligne maximale de 1 km pour la somme des lignes de puissance HT et des lignes de puissance BT et une longueur de ligne maximale de 1 km pour les lignes de communication peuvent être admises par hypothèse;

– dans le cas d'une structure qui comporte plusieurs lignes connectées avec des cheminements différents qui viennent alimenter le même réseau interne, les calculs doivent être effectués pour chaque ligne;

– dans le cas d'une structure qui comporte plusieurs lignes connectées avec le même cheminement qui vient alimenter le même réseau interne, les calculs ne doivent être réalisés que pour la ligne qui donne les valeurs N_l les plus élevées (ligne de communication ou ligne de puissance, ligne non écrantée ou ligne écrantée, ligne de puissance BT ou ligne de puissance HT avec transformateur HT/BT, etc.).

Si la structure est divisée en zones à risque Z_S (voir le 8.3), chaque composante de risque doit être évaluée pour chaque zone à risque Z_S.

Tableau 3 – Composantes de risque pour différentes sources de dommages et différents types de pertes

Type de perte	Source de dommages			
	S1 **Impact de foudre sur une structure**	**S2** **Impact de foudre à proximité d'une structure**	**S3** **Impact de foudre sur une ligne (entrante)**	**S4** **Impact de foudre à proximité d'une ligne**
L_1 Blessures sur êtres vivants	R_{AT} $= N_D \times P_{AT} \times P_P \times L_{AT}$		R_U $= (N_L + N_{DJ}) \times P_U \times P_P \times L_{UT}$	
	R_{AD} $= N_D \times P_{AD} \times P_P \times L_{AD}$			
	R_{B1} $= N_D \times P_B \times P_P \times L_{B1}$		R_{V1} $= (N_L + N_{DJ}) \times P_V \times P_P \times L_{V1}$	
	R_{C1} $= N_D \times P_C \times P_P \times P_e \times L_{C1}$ Voir la note de bas de page "a".	R_{M1} $= N_M \times P_M \times P_P \times P_e \times L_{M1}$ Voir la note de bas de page "a".	R_{W1} $= (N_L + N_{DJ}) \times P_W \times P_P \times P_e \times L_{W1}$ Voir la note de bas de page "a".	R_{Z1} $= N_I \times P_Z \times P_P \times P_e \times L_{Z1}$ Voir la note de bas de page "a".
L_2 Dommages physiques	R_{B2} $= N_D \times P_B \times L_{B2}$		R_{V2} $= (N_L + N_{DJ}) \times P_V \times L_{V2}$	
	R_{C2} $= N_D \times P_C \times P_e \times L_{C2}$ Voir la note de bas de page "b".	R_{M2} $= N_M \times P_M \times P_e \times L_{M2}$ Voir la note de bas de page "b".	R_{W2} $= (N_L + N_{DJ}) \times P_W \times P_e \times L_{W2}$ Voir la note de bas de page "b".	R_{Z2} $= N_I \times P_Z \times P_e \times L_{Z2}$ Voir la note de bas de page "b".

[a] R_{C1}, R_{M1}, R_{W1} et R_{Z1} s'appliquent généralement aux structures avec risque d'explosion et pour les hôpitaux ou autres structures dans lesquelles des défaillances des défaillances des réseaux internes entraînent des dangers mortels immédiats.

[b] R_{C2}, R_{M2}, R_{W2} et R_{Z2} s'appliquent généralement aux structures avec risque d'explosion.

8.3 Découpage d'une structure en zones à risque Z_S

Pour évaluer chaque composante de risque, une structure peut constituer (ou constitue par hypothèse) une zone simple ou peut être découpée en zones à risque Z_S, chacune possédant ses propres caractéristiques homogènes.

Les zones à risque Z_S sont généralement définies de la manière suivante:

– type de sol ou de plancher;
– compartiments à l'épreuve du feu;
– blindages spatiaux.

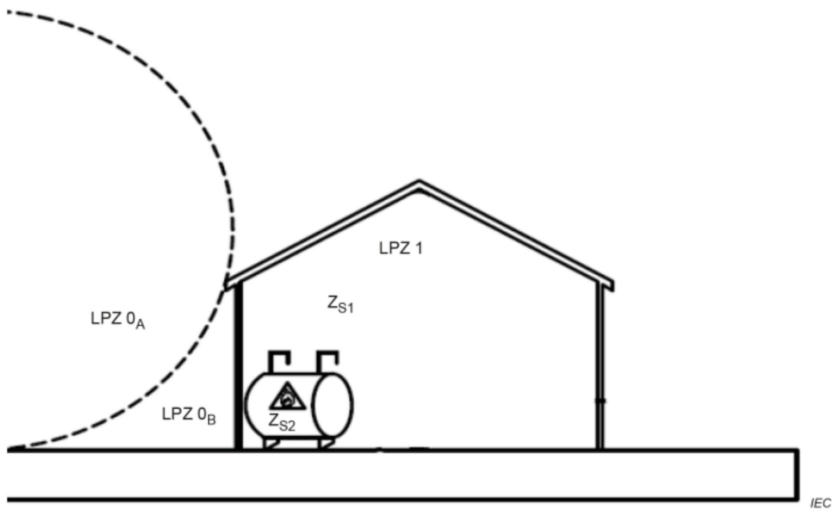
D'autres zones à risque peuvent être définies selon:

– la disposition des réseaux internes;
– les mesures de protection existantes ou à prévoir;
– les valeurs des pertes L_X.

Il convient que le découpage de la structure en zones à risque Z_S tienne compte de la faisabilité des mesures de protection les plus appropriées.

NOTE Il est souligné que les zones à risque Z_S sont définies par le concepteur pour l'appréciation du risque. Elles sont différentes des zones ZPF définies dans l'IEC 62305-1.

La Figure 2 donne un exemple de découpage en zones.



Légende

LPZ 0_A	impact direct, courant de foudre complet, champ électromagnétique complet
LPZ 0_B	pas d'impact direct, courant de foudre ou induit, champ électromagnétique complet
LPZ 1	pas d'impact direct, courant de foudre limité ou induit, champ électromagnétique H1 atténué (zone où le courant de choc est limité par les interfaces de répartition et d'isolement du courant ou par des SPD disposés à la frontière. Le blindage spatial peut affaiblir le champ électromagnétique de foudre.)
Z_{S1}	exemple de zone n° 1
Z_{S2}	exemple de zone n° 2

Figure 2 – Exemple de découpage en zones

8.4 Découpage d'une ligne en sections S_L

Pour évaluer les composantes de risque dû à un impact sur ou à proximité d'une ligne, il peut être admis par hypothèse que la ligne est une section simple, ou que celle-ci peut être divisée en sections différentes S_L.

Pour toutes les composantes de risque, les sections S_L sont essentiellement définies par:

– le type de ligne (aérienne ou enterrée, C_I);
– les caractéristiques de la ligne (blindée ou non, résistance du blindage);
– d'autres facteurs (C_D, C_E, C_T).

Si plusieurs valeurs pour un paramètre existent dans une section, l'hypothèse retenue doit être la valeur de risque la plus élevée (défavorable).

8.5 Évaluation des composantes de risque dans une zone d'une structure découpée en zones à risque Z_S

8.5.1 Critères généraux

Pour l'évaluation des composantes de risque et le choix des paramètres pertinents concernés, les règles suivantes s'appliquent:

- les paramètres pertinents pour le nombre N d'événements dangereux doivent être évalués conformément à l'Annexe A;
- les paramètres pertinents pour la probabilité P de dommages doivent être évalués conformément à l'Annexe B.

De plus:

- pour les composantes R_A, R_{B1}, R_{B2}, R_U, R_{V1}, R_{V2}, R_{W1}, R_{W2}, R_{Z1}, et R_{Z2}, seule une valeur doit être fixée dans chaque zone à risque pour chacun des paramètres concernés. Si plusieurs valeurs s'appliquent, la valeur la plus élevée doit être choisie;
- pour les composantes R_{C1}, R_{C2}, R_{M1}, et R_{M2}, si plusieurs réseaux internes sont impliqués dans une zone à risque, les valeurs de P_C et P_M sont données par:

$$P_C = 1 - (1 - P_{C1}) \times (1 - P_{C2}) \times \ldots \times (1 - P_{Cn}) \quad (10)$$

$$P_M = 1 - (1 - P_{M1}) \times (1 - P_{M2}) \times \ldots \times (1 - P_{Mn}) \quad (11)$$

  où P_{Cn} et P_{Mn} sont les paramètres qui correspondent au réseau interne n = 1, 2, 3…;
- les paramètres relatifs aux pertes doivent être calculés conformément à l'Annexe C.

À l'exception de P_C et P_M, si un paramètre a plusieurs valeurs dans une zone à risque, la valeur du paramètre qui conduit à la valeur de risque la plus élevée doit être retenue par hypothèse.

NOTE 1 Un réseau interne n'est pas nécessairement connecté directement à un service externe. Il peut par exemple être relié à une ligne de puissance en cuivre et à une ligne de données connectée par l'intermédiaire d'une interface d'isolement.

NOTE 2 Une approche plus simple consiste à utiliser $P_C = P_{C1}$ et $P_M = P_{M1}$ où P_{C1} et P_{M1} font référence au cas le plus défavorable.

8.5.2 Structure à une seule zone

Dans ce cas, une seule zone à risque Z_S définit l'ensemble de la structure. Le risque R est la somme des composantes de risque R_X dans cette zone à risque.

La définition de la structure en une seule zone à risque peut conduire à une dépense plus importante que nécessaire si une mesure de protection onéreuse doit s'étendre à l'ensemble de la structure, même si elle n'est pas essentielle sur la structure tout entière.

8.5.3 Structure à plusieurs zones

Dans ce cas, la structure est découpée en plusieurs zones à risque Z_S. Dans chaque zone à risque, le risque est la somme de toutes les composantes de risque correspondantes de la zone.

Le découpage de la structure en zones à risque permet au concepteur de prendre en compte les caractéristiques de chaque partie de la structure pour l'évaluation des composantes de risque et de choisir les mesures de protection les plus appropriées à chaque zone à risque, afin de réduire le coût total de la protection contre la foudre.

9 Fréquence des dommages et ses composantes

9.1 Fréquence des dommages

La fréquence des dommages F est la valeur du nombre d'événements qui provoquent des dommages causés par les sources de dommages S des réseaux de la structure à protéger.

Dans le cadre de l'évaluation de la nécessité d'une protection contre la foudre, la fréquence des dommages F doit être prise en compte par rapport à la perte de service L_3.

La fréquence de dommages F est la somme des fréquences partielles des dommages selon la source de dommages. Pour évaluer la fréquence des dommages F, la relation suivante s'applique:

$$F = F_C + F_M + F_W + F_Z \tag{12}$$

où

F_C est la fréquence des dommages dus à des impacts sur la structure (source S1);

F_M est la fréquence des dommages dus à des impacts à proximité de la structure (source S2);

F_W est la fréquence des dommages dus à des impacts sur la ligne (source S3);

F_Z est la fréquence des dommages dus à des impacts à proximité de la ligne (source S4).

La fréquence des dommages F_C fait référence aux défaillances des réseaux internes provoquées par des IEMF et par l'augmentation du potentiel à la terre en raison d'impacts sur la structure, F_M fait référence aux défaillances des réseaux internes provoquées par des IEMF en raison d'impacts sur le sol à proximité de la structure, tandis que les fréquences des dommages F_W et F_Z font référence aux défaillances des réseaux internes provoquées par des surtensions transmises à la structure par les lignes entrantes.

NOTE 1 La valeur de la fréquence des dommages F obtenue en additionnant les deux fréquences partielles des dommages F_M et F_Z peut être surestimée. Le risque peut être évalué de manière plus exacte en tenant compte du fait qu'un impact au sol a une incidence à la fois sur les réseaux internes par couplage inductif direct et sur la surtension induite sur les lignes connectées. Il en résulte que les fréquences partielles des dommages F_M et F_Z peuvent coïncider.

NOTE 2 Dans les réseaux de puissance internes, la composante de fréquence F_M est généralement négligeable.

NOTE 3 La fréquence des dommages causés par des impacts de foudre associée à une structure peut être évaluée pour un matériel. La fréquence des dommages d'un réseau interne ou d'une partie d'un réseau interne correspond dans tous les cas à celle du matériel le plus vulnérable parmi les matériels que l'utilisateur souhaite protéger (par défaut, l'ensemble des matériels).

9.2 Évaluation de la fréquence partielle des dommages

Chaque fréquence partielle des dommages F_C, F_M, F_W et F_Z, décrite au 9.1, peut être exprimée par l'équation générale suivante:

$$F_X = N_X \times P_X \tag{13}$$

où

N_X est le nombre annuel d'événements dangereux (voir aussi l'Annexe A);

P_X est la probabilité de dommages (voir aussi l'Annexe B);

Les équations pour calculer les fréquences partielles des dommages liées à chaque source de dommages sont données dans le Tableau 4.

Les valeurs des paramètres nécessaires au calcul des fréquences de dommages partielles figurent à l'Annexe A et l'Annexe B. Lorsque des TWS sont concernés, comme cela est décrit à l'Annexe B, ceux-ci doivent être conformes à l'IEC 62793.

Tableau 4 – Fréquences partielles des dommages pour chaque source de dommages

Type de perte	Source de dommages			
	S1 Impact de foudre sur une structure	**S2** Impact de foudre à proximité d'une structure	**S3** Impact de foudre sur une ligne (entrante)	**S4** Impact de foudre à proximité d'une ligne
L_3 perte de service due à une défaillance des réseaux internes	$F_C = N_D \times P_C \times P_e$	$F_M = N_M \times P_M \times P_e$	$F_W = (N_L + N_{DJ}) \times P_W \times P_e$	$F_Z = N_I \times P_Z \times P_e$

9.3 Procédure d'évaluation du besoin de protection pour la fréquence des dommages *F*

Une protection contre la foudre est nécessaire si la fréquence des dommages F dépasse le niveau tolérable F_T

$$F > F_T$$

Dans ce cas, il convient d'appliquer des mesures de protection afin de réduire la fréquence des dommages F à un degré qui ne dépasse pas le niveau de risque tolérable F_T

$$F \leq F_T$$

NOTE 1 Une valeur représentative du risque tolérable F_T est F_T = 0,1 [année]$^{-1}$ pour les réseaux internes essentiels pour assurer leur fonction en lien avec l'indisponibilité du service exigé, et F_T = 1 [année]$^{-1}$ pour les réseaux internes non essentiels. Les valeurs F_T = 0,1 et F_T = 1 fournies dans le présent document sont des valeurs classiques de la fréquence tolérable des dommages.

NOTE 2 La criticité des systèmes internes pour remplir leurs fonctions (par rapport à l'indisponibilité des services qui peut être tolérée) est prise en compte par le propriétaire ou le gestionnaire de la structure lors de la fixation de la valeur F_T.

NOTE 3 Si $F \leq F_T$, la protection contre la foudre n'est pas nécessaire pour réduire la fréquence des dommages, Les étapes suivantes doivent être prises pour évaluer le besoin de protection pour la fréquence des dommages F:

- calcul de la fréquence partielle des dommages F_X;
- calcul de la fréquence totale des dommages F;
- identification de la fréquence tolérable des dommages F_T;
- comparaison de la fréquence des dommages F à la valeur tolérable F_T.

La fréquence des dommages F doit être évaluée pour les réseaux internes ou les matériels à l'intérieur de la structure que le propriétaire souhaite protéger (lorsque la structure est découpée en zones, cela concerne chaque zone où se trouvent des matériels que le propriétaire ou le gestionnaire souhaite protéger). La fréquence F doit être comparée à F_T pour ces réseaux internes ou matériels.

La Figure 3 représente la procédure d'évaluation du besoin de protection pour la fréquence des dommages F.

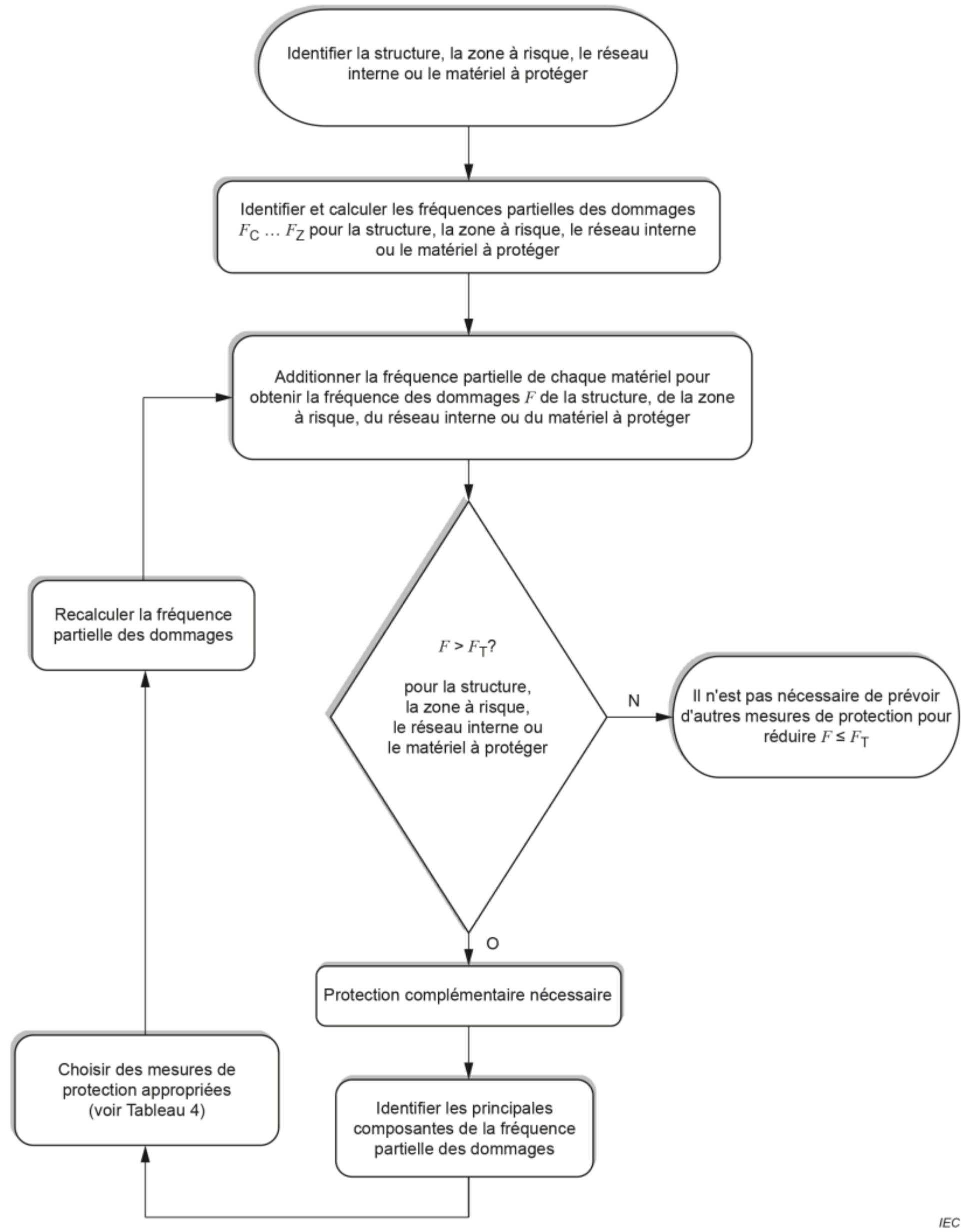


Figure 3 – Procédure de détermination du besoin de protection et de choix des mesures de protection

9.4 Évaluation de la fréquence partielle des dommages en zones

9.4.1 Critères généraux

Pour l'évaluation de la fréquence partielle des dommages et le choix des paramètres pertinents concernés, les règles suivantes s'appliquent:

– les paramètres pertinents pour le nombre N d'événements dangereux doivent être évalués conformément à l'Annexe A;

– les paramètres pertinents pour la probabilité P de dommages doivent être évalués conformément à l'Annexe B.

De plus:

– pour les fréquences partielles des dommages F_W et F_Z, une seule valeur doit être déterminée dans chaque zone à risque pour chacun des paramètres concernés. Si plusieurs valeurs s'appliquent, la valeur la plus élevée doit être choisie;

– pour les fréquences partielles des dommages F_C et F_M, si plusieurs réseaux internes sont concernés dans une zone à risque, les valeurs de P_C et P_M sont données par:

$$P_C = 1 - (1 - P_{C1}) \times (1 - P_{C2}) \times \ldots \times (1 - P_{Cn}) \tag{14}$$

$$P_M = 1 - (1 - P_{M1}) \times (1 - P_{M2}) \times \ldots \times (1 - P_{Mn}) \tag{15}$$

où P_{Cn} et P_{Mn} sont les paramètres qui correspondent au réseau interne n = 1, 2, 3…

Si un autre paramètre a plusieurs valeurs dans une zone à risque, la valeur du paramètre qui conduit à la valeur de fréquence partielle des dommages la plus élevée doit être retenue par hypothèse, sauf pour P_C et P_M.

NOTE 1 Un réseau interne n'est pas nécessairement connecté directement à un service externe. Il peut par exemple être relié à une ligne de puissance en cuivre et à une ligne de données connectée par l'intermédiaire d'une interface d'isolement.

NOTE 2 Une approche plus simple consiste à utiliser $P_C = P_{C1}$ et $P_M = P_{M1}$ où P_{C1} et P_{M1} font référence au cas le plus défavorable.

9.4.2 Structure à une seule zone

Dans ce cas, une seule zone à risque Z_S qui englobe l'ensemble de la structure est définie. La fréquence des dommages F est la somme des fréquences partielles des dommages F_X dans cette zone à risque.

La définition de la structure en une seule zone à risque peut conduire à des mesures de protection onéreuses, car chaque mesure doit s'étendre à l'ensemble de la structure.

9.4.3 Structure à plusieurs zones

Dans ce cas, la structure est découpée en plusieurs zones à risque Z_S. La fréquence des dommages F_{zone} pour la zone à risque est la somme des fréquences partielles des dommages $F_{zone/X}$ qui correspondent à toutes les sources de dommages.

Le découpage de la structure en zones à risque permet au concepteur de prendre en compte les caractéristiques de chaque partie de la structure pour l'évaluation de la fréquence partielle des dommages et de choisir les mesures de protection les plus appropriées zone à risque par zone à risque, afin de réduire le coût total de la protection contre la foudre.

Annexe A
(informative)

Évaluation du nombre annuel N d'événements dangereux

A.1 Généralités

Le nombre annuel moyen N d'événements dangereux dus aux impacts de foudre qui impliquent une structure à évaluer dépend de la densité de points d'impact au sol de la foudre dans la région où se situe la structure et de ses caractéristiques physiques.

La densité de points d'impact au sol de la foudre N_{SG} correspond au nombre d'impacts de foudre par km^2 et par an. Dans de nombreuses régions du monde, cette valeur peut être obtenue à partir des données fournies par des systèmes de localisation de la foudre (LLS) conformes à l'IEC 62858.

Lorsque les valeurs N_{SG} ne sont pas directement disponibles, il est possible de compter les éclairs au moyen des différents points d'impact au sol. Les valeurs de densité de foudroiement au sol N_G peuvent être multipliées par un facteur k pour estimer N_{SG} en fonction de plusieurs facteurs tels que l'emplacement géographique. Il convient d'obtenir ce facteur k auprès du fournisseur national de données de LLS.

$$N_{SG} = k\ N_G \tag{A.1}$$

où

N_{SG} est la densité de points d'impact au sol de la foudre (1 par km^2 et par an).

NOTE 1 Lorsque le fournisseur de données de LLS ne peut pas fournir ce facteur k ou qu'il n'existe pas (par exemple, lorsqu'un pays dispose d'une carte N_G), un facteur de 2 peut être admis par hypothèse.

Dans les régions qui ne comportent pas de systèmes de localisation de la foudre au sol, l'estimation recommandée pour la densité de points d'impact au sol de la foudre est

$$N_{SG} = 0{,}5\ N_T \tag{A.2}$$

où N_T est la densité totale (CG sol + IC nuage) d'éclairs optiques enregistrés par km^2 et par an, obtenue sur le site web de la NASA http://lightning.nsstc.nasa.gov/data/data_lis-otd-climatology.html [7].

NOTE 2 Dans la plupart des régions du monde, une indication de l'activité de foudre peut être obtenue à partir d'observations des transitoires optiques de la foudre. Les détecteurs sur satellite répondent à tous les types de foudres avec une couverture relativement uniforme. Moyennant un lissage suffisant, les données de densité de transitoires optiques donnent de meilleures estimations de la densité de foudroiement au sol que les observations de l'orage, qui présentent un large éventail de relations entre la densité de foudroiement au sol et les heures ou jours d'orage. Il existe aussi des variations régionales dans le rapport du nombre d'impacts au sol (CG) sur le nombre total d'impacts (CG + IC).

NOTE 3 L'IEC 62858 spécifie comment les données relatives à la foudre sont obtenues et représentées.

Les événements suivants peuvent être considérés comme dangereux pour une structure dont la protection est envisagée:

– impacts sur la structure;
– impacts sur le sol à proximité de la structure;
– impacts sur une ligne qui entre dans la structure, y compris les impacts sur une autre structure à laquelle la ligne est connectée;
– impacts sur le sol à proximité d'une ligne qui entre dans la structure.

NOTE 4 L'Annexe A fournit des méthodes simplifiées pour calculer le nombre N d'événements dangereux dus à des impacts de foudre qui impliquent une structure à protéger.

A.2 Évaluation du nombre annuel moyen d'événements dangereux N_D dus aux impacts sur une structure et N_{DJ} sur une structure adjacente

A.2.1 Détermination de la surface d'exposition A_D

A.2.1.1 Généralités

Pour des structures isolées en terrain plat, la surface équivalente d'exposition A_D est la zone définie par l'intersection entre la surface du sol et une droite avec une pente de 1/3 qui passe par les parties les plus élevées de la structure (en les touchant à cet endroit) et en tournant autour de celle-ci. La détermination de la valeur de A_D peut être effectuée par une méthode graphique ou mathématique.

A.2.1.2 Structure rectangulaire

Pour une structure rectangulaire isolée de longueur L, de largeur W et de hauteur H sur un sol plat, la surface équivalente d'exposition est égale à:

$$A_D = L \times W + 2 \times (3 \times H) \times (L + W) + \pi \times (3 \times H)^2 \quad \text{(A.3)}$$

où L, W et H sont exprimés en mètres (voir la Figure A.1).

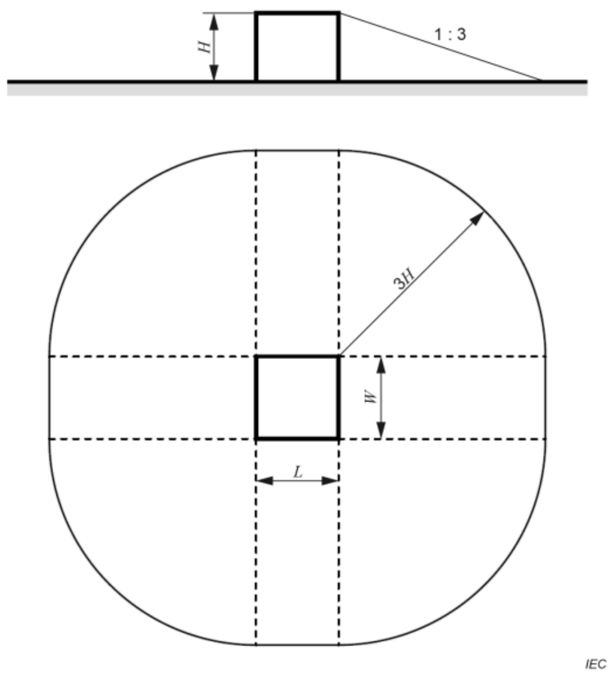


Figure A.1 – Surface d'exposition A_D d'une structure isolée

A.2.1.3 Structure de forme complexe

Si la structure a une forme complexe, par exemple avec toiture élevée saillante (voir la Figure A.2), il convient d'utiliser une méthode graphique pour évaluer A_D (voir la Figure A.3).

Une valeur approximative acceptable de la surface d'exposition est la valeur maximale entre la surface équivalente d'exposition A_{DMIN}, évaluée au moyen de l'Équation (A.3) en tenant compte de la hauteur minimale H_{MIN} de la structure, et la surface d'exposition attribuée à la toiture élevée saillante A_D'. A_D' peut être calculée de la façon suivante:

$$A_D' = \pi \times (3 \times H_P)^2 \quad \text{(A.4)}$$

où H_P est la hauteur de la saillie.

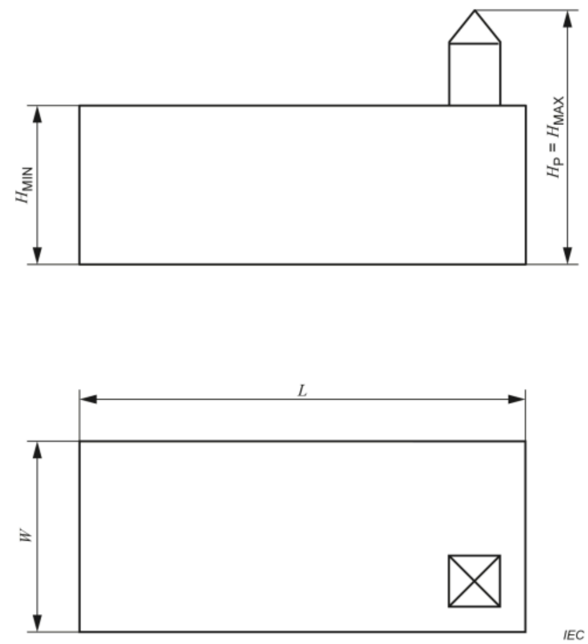


Figure A.2 – Structure de forme complexe

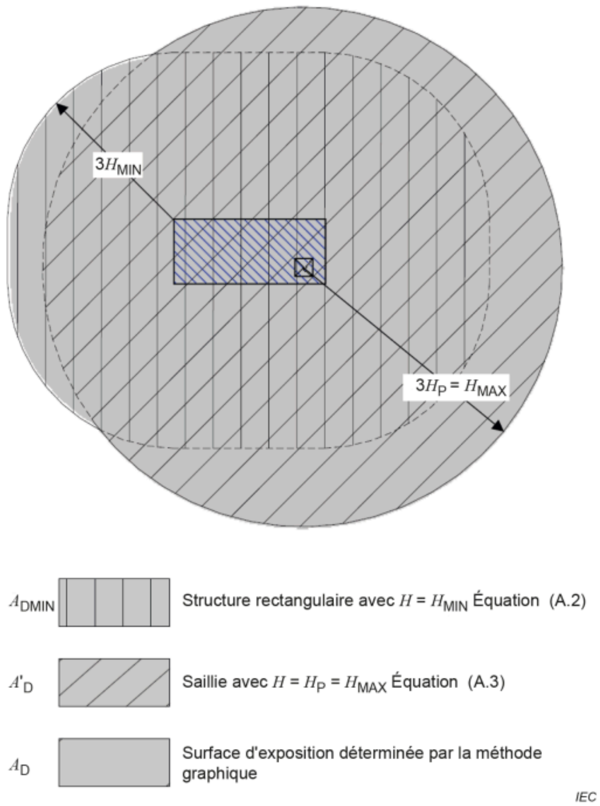


Figure A.3 – Différentes méthodes de détermination de la surface d'exposition d'une structure donnée

A.2.2 Structure qui fait partie d'un bâtiment

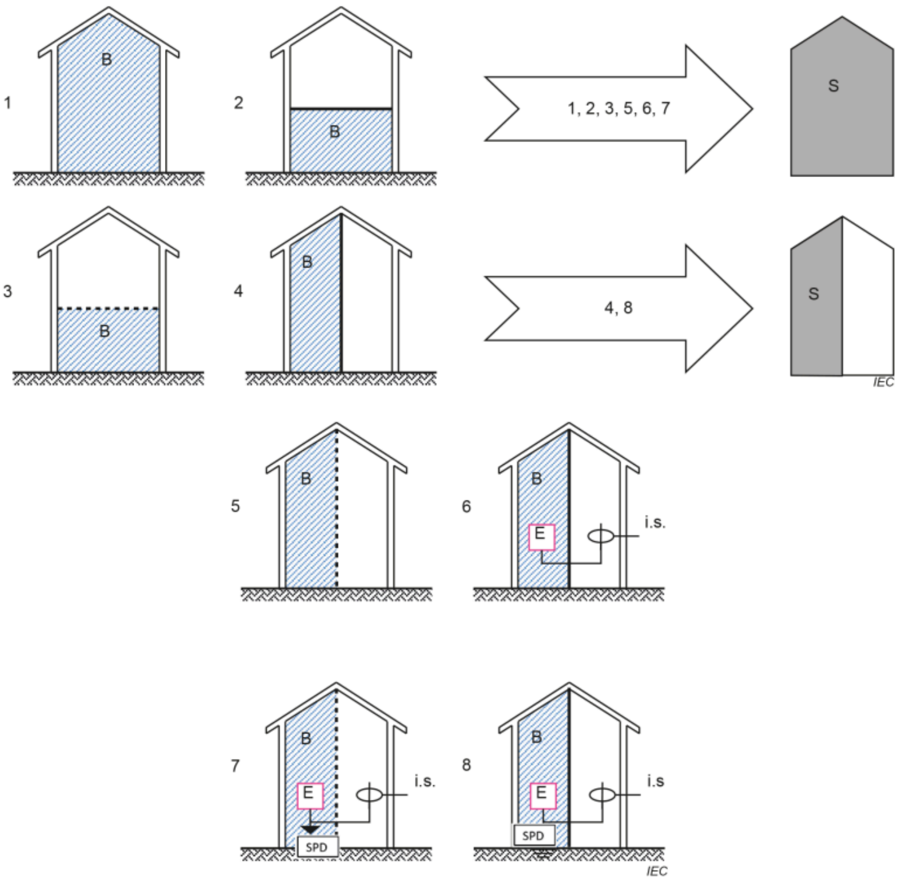
Lorsque la structure S à examiner correspond à une seule partie d'un bâtiment B, les dimensions de la structure S peuvent être utilisées dans l'évaluation de A_D si les conditions suivantes sont remplies (voir la Figure A.4):

- la structure S est une partie verticale séparée du bâtiment B, comme cela est représenté sur la Figure A.4;
- le bâtiment B est une structure sans risque d'explosion;
- la propagation d'un incendie entre la structure S et d'autres parties du bâtiment B est atténuée au moyen, par exemple, de parois qui présentent une résistance au feu de 120 min ou au moyen d'autres mesures de protection équivalentes;

NOTE Les réglementations en matière d'incendie peuvent établir différentes valeurs pour la résistance au feu. Les réglementations relatives aux bâtiments peuvent définir la résistance au feu des murs.

- la propagation des surtensions le long des lignes communes, s'il y en a, est évitée au moyen de SPD installés au point d'entrée de telles lignes dans la structure ou au moyen d'autres mesures de protection équivalentes.

Lorsque ces conditions ne sont pas remplies, il convient d'utiliser les dimensions de l'ensemble du bâtiment B.



Légende

B bâtiment ou partie de celui-ci pour lequel la protection est envisagée (l'évaluation de A_D est nécessaire)

partie de bâtiment pour laquelle la protection n'est pas envisagée (l'évaluation de A_D n'est pas nécessaire)

S structure à prendre en compte pour l'appréciation du risque (les dimensions de S doivent être utilisées pour l'évaluation de A_D)

découpage avec résistance au feu ≥ 120 min

découpage avec résistance au feu < 120 min

E matériel

i.s. réseau interne

SPD SPD

Figure A.4 – Structure à prendre en compte pour l'évaluation de la surface d'exposition A_D

A.2.3 Emplacement relatif de la structure

L'emplacement relatif d'une structure, qui dépend des structures environnantes ou de l'exposition de la structure, est pris en compte par un facteur d'emplacement C_D (voir le Tableau A.1).

Une évaluation plus précise de l'influence des objets environnants peut être obtenue en tenant compte de la hauteur relative de la structure par rapport aux objets qui l'entourent ou au sol à une distance de 3 × H de la structure et en formulant l'hypothèse C_D = 1.

Tableau A.1 – Facteurs d'emplacement C_D et C_{DJ} de la structure

Emplacement relatif	C_D ou C_{DJ}
Structure entourée par des objets plus hauts	0,25
Structure entourée par des objets de la même hauteur ou plus faible	0,5
Structure isolée, pas d'autres objets à proximité	1
Structure isolée au sommet d'une colline ou sur un monticule	2

NOTE 1 Une méthode plus complète fondée sur des modèles 3D peut fournir des résultats approfondis, en tenant compte de l'incidence des bâtiments environnants et de l'environnement.

NOTE 2 La méthode courante pour déterminer le coefficient C_D ou C_{DJ} consiste à déterminer l'influence des objets à une distance maximale de 3H du bâtiment concerné (chevauchement des surfaces d'exposition).

NOTE 3 C_D est représentatif d'une surface équivalente d'exposition de la structure; C_D dépend de la hauteur des structures environnantes, de la largeur et, en général, de l'exposition des structures environnantes. Il ne s'agit pas d'un simple calcul géométrique. Cependant, à titre indicatif, C_D = 0,25 peut être pris comme exemple lorsque la surface d'exposition de la structure physique et le sol à une distance maximale de 3 × H sont constamment compris à 75 % dans la surface d'exposition des objets environnants. C_D = 0,5, par exemple, lorsque la surface d'exposition de la structure physique et le sol à une distance maximale de 3 × H sont constamment compris à 50 % dans la surface d'exposition des objets environnants. C_D = 1, par exemple, lorsque la surface d'exposition de la structure physique et le sol à une distance maximale de 3 × H sont marginalement compris dans la surface d'exposition des objets environnants.

A.2.4 Nombre d'événements dangereux N_D pour la structure

N_D peut être évalué comme le produit:

$$N_D = N_{SG} \times A_D \times C_D \times 10^{-6} \quad \text{(A.5)}$$

où

N_{SG} est la densité de points d'impact au sol de la foudre par km^2 et par an;

A_D est la surface équivalente d'exposition de la structure (m^2);

C_D est le facteur d'emplacement de la structure (voir le Tableau A.1).

NOTE Dans les zones qui comportent des structures de grande hauteur isolées, une évaluation plus précise de N_D peut être conseillée. Les comités nationaux peuvent fournir de plus amples informations.

A.2.5 Nombre d'événements dangereux N_{DJ} pour une structure adjacente

Le nombre annuel moyen d'événements dangereux dus aux impacts sur une structure connectée à l'extrémité d'une ligne, N_{DJ}, peut être évalué comme le produit:

$$N_{DJ} = N_{SG} \times A_{DJ} \times C_{DJ} \times C_T \times 10^{-6} \quad \text{(A.6)}$$

où

N_{SG} est la densité de points d'impact au sol de la foudre par km^2 et par an;

A_{DJ} est la surface équivalente d'exposition de la structure adjacente (m^2);

C_{DJ} est le facteur d'emplacement de la structure adjacente (voir le Tableau A.1);

C_T est le facteur de type de ligne (voir le Tableau A.3).

A.3 Évaluation du nombre annuel moyen d'événements dangereux N_M dus aux impacts à proximité d'une structure

N_M peut être évalué comme le produit:

$$N_M = (1/\ k) \times N_{SG} \times A_M \times 10^{-6} \quad \text{(A.7)}$$

où

N_{SG} est la densité de points d'impact au sol de la foudre par km^2 et par an;

A_M est la surface équivalente d'exposition pour les impacts à proximité de la structure (m^2).

NOTE 1 Lorsque la densité N_{SG} est obtenue directement par LLS, le facteur k est fourni par le fournisseur de données de LLS. En cas d'indisponibilité, un facteur k = 2 peut être retenu par hypothèse (voir l'Article A.1).

NOTE 2 Dans les réseaux de puissance, les événements dangereux N_M peuvent généralement être ignorés en raison de l'utilisation d'une construction en béton à maillage de barres d'armature dense.

NOTE 3 Le facteur d'environnement C_E peut également avoir une influence sur N_M, par exemple, N_M peut être multiplié par le facteur d'environnement C_E.

La surface équivalente d'exposition A_M s'étend jusqu'à une ligne située à une distance conventionnelle r_M du périmètre de la structure:

$$A_M = 2 \times r_M \times (L + W) + \pi \times r_M{}^2 \quad \text{(A.8)}$$

où

r_M = 350/U_w (m);

U_w est la tension de choc assignée en kV du matériel dont le niveau d'isolement est le plus faible.

NOTE 4 Les valeurs habituelles de U_W peuvent être consultées dans le Tableau B.11 et dans le Tableau B.12.

A.4 Évaluation du nombre annuel moyen d'événements dangereux N_L dus à des impacts sur une ligne

Une ligne peut comprendre plusieurs sections. Pour chaque section de ligne, la valeur de N_L peut être évaluée de la façon suivante:

$$N_L = N_{SG} \times A_L \times C_I \times C_E \times C_T \times 10^{-6} \quad \text{(A.9)}$$

où

N_L est le nombre de surtensions d'amplitude supérieure ou égale à 1 kV (1/an) sur la section de ligne;

N_{SG} est la densité de points d'impact au sol de la foudre par km^2 et par an;

A_L est la surface équivalente d'exposition aux impacts sur la ligne (m^2);

C_I est le facteur d'installation de la ligne (voir le Tableau A.2);

C_T est le facteur de type de ligne (voir le Tableau A.3);

C_E est le facteur d'environnement (voir le Tableau A.4)

avec la surface équivalente d'exposition pour les impacts sur une ligne:

$$A_L = 40 \times L_L \quad \text{(A.10)}$$

où

L_L est la longueur de la section de ligne (m).

Lorsqu'aucune information relative à la longueur des sections n'est disponible, une longueur de ligne maximale de 1 km pour la somme des lignes de puissance HT et des lignes de puissance BT et une longueur de ligne maximale de 1 km pour les lignes de communication peuvent être admises par hypothèse;

NOTE 1 Plus d'informations sur les surfaces équivalentes d'exposition A_L des lignes de communication peuvent être obtenues dans la Recommandation UIT-T K.47 [8].

NOTE 2 En général, 2 km est une longueur totale maximale réaliste à prendre en compte pour les lignes de puissance.

Tableau A.2 – Facteur d'installation de ligne C_I

Cheminement	C_I
Aérien	1
Enterré	0,3
Câbles enterrés entièrement posés dans un réseau maillé de terre (IEC 62305-4:2024, 5.2).	0,01

NOTE 3 La résistivité du sol a un impact sur la surface d'exposition A_L des sections enterrées. En règle générale, plus la résistivité du sol est importante, plus la surface équivalente d'exposition est grande. Le facteur d'installation du Tableau A.2 est fondé sur ρ = 400 Ωm. Pour ρ > 400 Ωm, l'équation suivante pour une section enterrée peut être utilisée: $A_L = 0,6 \times \sqrt{\rho} \times L_L$.

Tableau A.3 – Facteur de type de ligne C_T

Installation	C_T
Ligne de puissance BT, de communication ou de transmission de données, ou ligne de puissance HT avec autotransformateur HT/BT	1
Ligne de puissance HT (avec transformateur HT/BT à enroulements séparés)	0,2

NOTE 5 D'autres valeurs peuvent être attribuées au facteur de type de ligne C_T après une étude approfondie. Des valeurs plus faibles sont possibles pour C_T.

Tableau A.4 – Facteur d'environnement C_E

Environnement	C_E
Rural	1
Suburbain	0,5
Urbain	0,1
Urbain avec des bâtiments de hauteur supérieure à 20 m	0,01

NOTE 6 Les valeurs données à C_E réduisent le nombre d'événements dangereux causés par les sources S3 et S4 en raison de la protection des structures environnantes.

NOTE 7 D'autres valeurs peuvent être attribuées au facteur d'environnement C_E après une étude approfondie.

A.5 Évaluation du nombre annuel moyen d'événements dangereux N_I dus à des impacts à proximité d'une ligne

Une ligne peut comprendre plusieurs sections. Pour chaque section de ligne, la valeur de N_I peut être évaluée comme suit:

$$N_I = (1/k) \times N_{SG} \times A_I \times C_I \times C_E \times C_T \times 10^{-6} \quad \text{(A.11)}$$

où

N_I est le nombre annuel de surtensions d'amplitude supérieure à U_W sur la section de ligne;

N_{SG} est la densité de points d'impact au sol de la foudre par km^2 et par an;

A_I est la surface équivalente d'exposition pour les impacts sur le sol à proximité de la ligne (m^2);

C_I est le facteur d'installation (voir le Tableau A.2);

C_T est le facteur de type de ligne (voir le Tableau A.3);

C_E est le facteur d'environnement (voir le Tableau A.4).

NOTE 1 Lorsque la densité N_{SG} est obtenue directement par LLS, le facteur k est fourni par le fournisseur de données de LLS. En cas d'indisponibilité, un facteur k = 2 peut être retenu par hypothèse (voir l'Article A.1).

La surface équivalente d'exposition A_I des impacts à proximité d'une ligne s'étend à une ligne située à une distance conventionnelle r_I de la ligne:

$$A_\mathrm{I} = 2 \times r_\mathrm{I} \times L_\mathrm{L} \tag{A.12}$$

où

L_L est la longueur de la section de ligne (m);

r_I $= 2\,000/U_\mathrm{w}^{1,8}$;

U_w est la tension assignée de choc en kV du matériel.

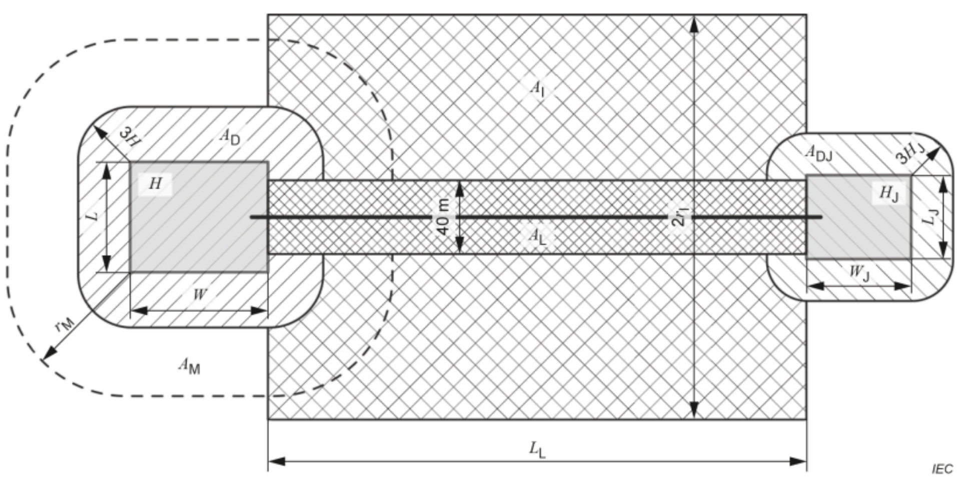
Lorsqu'aucune information relative à la longueur des sections n'est disponible, une longueur de ligne maximale de 1 km pour la somme des lignes de puissance HT et des lignes de puissance BT et une longueur de ligne maximale de 1 km pour les lignes de communication peuvent être admises par hypothèse;

NOTE 2 Une évaluation plus précise de A_I peut être trouvée dans la publication Electra n° 161 [9] et n° 162 [10], 1995 pour les lignes de puissance et dans la Recommandation UIT-T K.46 [11] pour les lignes de communication.

NOTE 3 En général, 2 km est une longueur totale maximale réaliste à prendre en compte pour les lignes de puissance.

A.6 Représentation des surfaces équivalentes d'exposition

La Figure A.5 représente la relation entre les cinq surfaces d'exposition A_D, A_DJ, A_M, A_L et A_I, respectivement spécifiées en A.2.1.2, en A.2.1.3, à l'Article A.3, à l'Article A.4 et à l'Article A.5. Il convient de noter que les zones ne sont pas représentées à l'échelle par rapport aux dimensions habituelles.



NOTE La figure représente la surface d'exposition d'une distance latérale spécifique.

Figure A.5 – Surfaces équivalentes d'exposition A_D, A_DJ, A_M, A_L et A_I

Annexe B
(informative)

Évaluation de la probabilité de dommages P_X

B.1 Généralités

Les probabilités données dans la présente Annexe B sont valables si les mesures de protection sont conformes à:

- l'IEC 62305-3 pour les mesures de protection qui réduisent les blessures sur des êtres humains et les dommages physiques;
- l'IEC 62305-4 pour les mesures de protection qui réduisent les défaillances des réseaux internes.

D'autres valeurs peuvent être choisies si cela est justifié.

Les valeurs des probabilités P_X inférieures à 1 ne peuvent être choisies que si la mesure ou la caractéristique est valable pour la structure entière ou une zone à risque de la structure (Z_S) à protéger et pour tous les matériels associés.

Il convient que les valeurs des probabilités P_X tiennent compte de la probabilité P_{TWS} si les dispositions de protection correspondantes fournies sont activées à l'aide d'un système d'alerte aux orages (TWS) conforme à l'IEC 62793, où P_{TWS} est la probabilité qu'un TWS ne détecte pas un phénomène de foudre dans la zone cible.

NOTE 1 P_{TWS} = valeur maximale entre le taux de défaillance d'alerte (FTWR, *Failure to Warn Ratio*) et 1 − la probabilité qu'un délai de x minutes soit obtenu (POD_x). Le FTWR et POD_x figurent généralement sur la fiche produit du fabricant ou sont communiqués par le fournisseur de service. Il peut être admis par hypothèse que P_{TWS} = 1 si le fabricant ne déclare pas la valeur de FTWR ou POD_x.

NOTE 2 Pour les mesures de protection et les valeurs de réduction obtenues au moyen d'un TWS, voir l'IEC 62305-1 et l'IEC 62793. Si aucune mesure préventive temporaire ne s'applique ou si aucun TWS n'est prévu, il peut être admis par hypothèse que P_{TWS} = 1. Si l'avertissement donné par le TWS n'accorde pas suffisamment de temps pour prendre ces mesures, il peut être admis par hypothèse que P_{TWS} = 1.

Il convient que les valeurs des facteurs à utiliser pour évaluer la probabilité P_X de dommages soient fixées par le concepteur du système de protection contre la foudre. Les valeurs de facteurs dans une structure données dans la présente Annexe B sont des valeurs types. D'autres valeurs peuvent être attribuées après une étude approfondie.

La probabilité P_X que les mesures de protection réduisent les défaillances des réseaux internes dépend de la probabilité P_{SPD} d'un système de protection par parafoudres coordonnés. En fonction du niveau de protection contre la foudre (NPF) choisi, un système de protection par parafoudres coordonnés doit:

- résister au courant de foudre prévu au point d'installation;
- limiter la valeur de surtension à l'entrée du matériel à une valeur inférieure ou égale à la tension de choc assignée (U_w).

La probabilité P_{SPD} qui correspond au système de protection par parafoudres coordonnés dépend:

- de la probabilité P_Q que la valeur de la charge prévue, associée au courant qui passe par le SPD à son point d'installation, dépasse la valeur tolérée par le SPD;
- de la probabilité P_{Up} que la valeur de tension résiduelle au niveau du parafoudre dépasse le niveau de protection exigé U_{pr} afin de réduire la valeur de surtension à l'entrée du matériel à une valeur inférieure ou égale à la tension de choc assignée (U_w)du matériel.

Alors la probabilité P_{SPD} est donnée par:

$$P_{SPD} = 1 – (1 – P_Q)(1 – P_{Up}) \quad (B.1)$$

La probabilité P_Q fait référence aux premiers coups de foudre positif et négatif, tandis que la probabilité P_{Up} fait référence aux impacts suivants des éclairs négatifs.

NOTE 3 Les réseaux internes peuvent comprendre des matériels montés à l'extérieur, à condition qu'ils ne soient pas exposés à un coup de foudre direct, selon la classe de SPF choisie.

B.2 Probabilité P_{AT} qu'un impact sur une structure provoque des tensions dangereuses de contact et de pas

Les valeurs de probabilité P_{AT} d'apparition de dommages causés par des tensions de contact et de pas en raison d'impacts sur une structure dépendent des mesures de protection prévues:

$$P_{AT} = P_{LPS} \times P_{am} \times r_t \times P_{TWS} \quad (B.2)$$

où

P_{LPS} est la probabilité, en fonction du NPF, que les mesures protègent les zones exposées de la structure contre les impacts directs. Les valeurs de P_{LPS} sont données dans le Tableau B.3;

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

NOTE 1 L'objet d'un message d'alerte créé par un TWS est d'assurer une évacuation immédiate et complète de la zone exposée. Si cette évacuation n'est pas assurée ou si aucun TWS n'est prévu, ou si le fabricant ne déclare pas le FTWR, il est admis par hypothèse que P_{TWS} = 1 (voir aussi l'IEC 62305-1 et l'IEC 62793 pour les restrictions d'application d'un TWS).

P_{am} est la probabilité qu'un impact sur une structure provoque des dommages dus à des tensions de contact et de pas selon les différentes mesures de protection prises. Les valeurs de P_{am} sont données dans le Tableau B.1;

r_t est le facteur de réduction en fonction du type de surface du sol ou du plancher. Les valeurs de r_t sont données dans le Tableau B.2.

NOTE 2 Les mesures de protection ne réduisent efficacement P_{AT} qu'à l'intérieur de structures protégées par un SPF ou de structures à armature continue en métal ou en béton armé qui agit comme un SPF naturel.

Tableau B.1 – Valeurs de probabilité P_{am} qu'un impact sur une structure provoque des dommages dus à des tensions de contact et de pas selon les différentes mesures de protection prises

Mesure de protection	P_{am}
Pas de mesures de protection	1
Panneau d'avertissement	10^{-1}
Isolation électrique (par exemple, au moins 3 mm de polyéthylène réticulé) des parties exposées (par exemple, conducteurs de descente)	10^{-2}
Sol équipotentiel efficace réalisé au moyen d'un réseau de prises de terre maillé[a]	10^{-2}
SPF naturel, voir la Note 3	10^{-3}
Restrictions d'accès	0
[a] Mesure de protection efficace contre les tensions de pas uniquement.	

Si plusieurs mesures de protection ont été prises, la valeur de P_{am} est le produit des valeurs correspondantes.

NOTE 3 Il peut être admis par hypothèse que P_{am} = 0,001 lorsque la structure:

- est équipée d'une armature métallique complète (voir l'IEC 62305-3:2024, 8.1 et 8.2);
- est en béton armé coulé sur place, les tiges de renfort étant reliées conformément à l'IEC 62305-3 et vérifiées conformément à la méthode décrite dans l'IEC 62305-3:2024, Annexe D;
- est prévue avec un réseau de prises de terre maillé, sans installation métallique accessible qui peut faire partie de la trajectoire du courant de foudre.

Tableau B.2 – Facteur de réduction r_t en fonction du type de surface du sol ou du plancher

Type de surface[a]	Résistance de contact[b] kΩ	r_t
Agricole, béton	≤ 1	10^{-2}
Marbre, céramique	1–10	10^{-3}
Gravier, moquette, tapis	10–100	10^{-4}
Asphalte, linoléum, bois	≥ 100	10^{-5}

NOTE Une attention particulière est prise lorsque les couches de protection isolantes au sol sont mouillées ou recouvertes d'une pellicule d'eau.

[a] Une couche en matériau isolant, par exemple en asphalte de 5 cm d'épaisseur, réduit généralement le danger à un niveau tolérable. Dans de tels cas, il peut être admis par hypothèse que r_t = 0.

[b] Résistance de contact selon la définition IEV 581-23-08. Valeurs mesurées entre une électrode de 400 cm^2 comprimée avec une force uniforme de 750 N et un point où la tension n'est pas modifiée par une injection de courant.

B.3 Probabilité P_{AD} qu'un impact entraîne des dommages sur une personne exposée qui se tient sur la structure

Les valeurs de probabilité P_{AD} qu'un éclair frappe une personne sur la structure dépendent de la position de la personne dans la zone exposée, du niveau de protection contre la foudre (NPF) des mesures prises pour protéger les zones exposées de la structure contre les impacts directs et des mesures de protection complémentaires prévues:

$$P_{AD} = P_{TWS} \times P_{am} \times P_{O} \times P_{LPS} \tag{B.3}$$

où

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

NOTE 1 L'objet d'un message d'alerte créé par un TWS est d'assurer une évacuation immédiate et complète de la zone exposée. Si cette évacuation n'est pas assurée ou si aucun TWS n'est prévu, ou si le fabricant ne déclare pas le FTWR, il est admis par hypothèse que $P_{TWS} = 1$ (voir aussi l'IEC 62305-1:2024, 7.1 pour les restrictions d'application d'un TWS).

NOTE 2 Lorsqu'un TWS est utilisé, la probabilité P_{am} peut être ignorée.

P_{am} est la probabilité qu'un impact sur une structure provoque des dommages dus à des tensions de contact et de pas selon les différentes mesures de protection prises. Les valeurs de P_{am} sont données dans le Tableau B.1;

P_{O} est le facteur de probabilité en fonction de la position d'une personne dans la zone exposée, où P_{O} est par hypothèse égal à 1 lorsque la personne est exposée (et égal à 0 lorsqu'il n'y a personne);

P_{LPS} est la probabilité, en fonction du NPF, que les mesures protègent les zones exposées de la structure contre les impacts directs. Les valeurs de P_{LPS} sont données dans le Tableau B.3;

NOTE 3 La probabilité P_{LPS} peut être incluse dans l'Équation (B.3) uniquement lorsque des personnes se trouvent dans la zone protégée du SPF.

P_{am} est la probabilité qu'un impact sur une structure provoque des dommages dus à des tensions de contact et de pas.

Tableau B.3 – Valeurs de probabilité P_{LPS} qui dépend des mesures destinées à protéger les zones exposées de la structure contre les impacts directs et à réduire les dommages physiques

Caractéristiques de la structure	Classe de SPF	P_{LPS}
Structure ou zones exposées non protégées	-	1
Structure ou zones exposées protégées par un SPF	IV	0,2
	III	0,1
	II	0,05
	I	0,02
Structure protégée par un SPF I avec armature continue en métal ou en béton armé qui agit comme réseau de conducteurs de descente naturels		0,01
Structure protégée par un SPF I avec toiture métallique et dispositif de capture, avec la possibilité d'inclure des composants naturels, qui assure une protection complète des matériels sur le toit contre les coups de foudre directs et armature continue en métal ou en béton armé qui agit comme réseau de conducteurs de descente naturels		0,001

NOTE 4 Des valeurs de P_{LPS} autres que celles données dans le Tableau B.3 sont possibles si elles reposent sur une évaluation approfondie en tenant compte des exigences de dimensionnement et les critères d'interception définis dans l'IEC 62305-1.

NOTE 5 Les caractéristiques du SPF, y compris celles du parafoudre pour la liaison équipotentielle de foudre, sont indiquées dans l'IEC 62305-3.

NOTE 6 Le niveau de protection du SPF peut être différent pour la protection des zones exposées de la structure contre les impacts directs ou pour réduire les dommages physiques.

NOTE 7 Pour plus d'informations, voir l'IEC 62305-3:2024, 8.1 et 8.2.

B.4 Probabilité P_B qu'un impact sur une structure entraîne des dommages physiques par incendie ou explosion

La probabilité P_B qu'un impact sur une structure entraîne des dommages physiques par incendie ou explosion est donnée par:

$$P_B = P_S \times P_{LPS} \times r_f \times r_p \quad \text{(B.4)}$$

où

P_S est la probabilité qu'un impact sur une structure provoque un étincelage dangereux. Les valeurs de P_S sont données dans le Tableau B.4;

P_{LPS} est la probabilité qui dépend des mesures de protection prises pour réduire les dommages physiques. Les valeurs de P_{LPS} sont données dans le Tableau B.3;

r_p est le facteur de réduction en fonction des dispositions prises pour réduire les conséquences d'un incendie. Les valeurs de r_p sont données dans le Tableau B.5;

r_f est le facteur de réduction en fonction du risque d'incendie ou d'explosion de la structure. Les valeurs de r_f sont données dans le Tableau B.6.

Tableau B.4 – Valeurs de probabilité P_S qu'un impact sur une structure provoque un étincelage dangereux

Type de structure	P_S
Bois et maçonnerie	1
Armature en béton armé à continuité électrique ou structure métallique interconnectée	0,5

NOTE 1 Si aucun SPF n'est installé ou si le SPF n'est pas installé conformément à l'IEC 62305-3, le Tableau B.4 donne la valeur de P_S. Si un SPF est installé conformément à l'IEC 62305-3, P_S = 1 et l'effet bénéfique sur le SPF est pris en compte par P_{LPS}.

NOTE 2 En cas de présence de parties métalliques qui font particulièrement saillie et non raccordées à l'armature de la structure, P_S = 1 peut être adopté.

NOTE 3 Lorsque les parois et la toiture ne sont pas du même type, une valeur plus élevée pour P_S peut être envisagée.

NOTE 4 En ce qui concerne les armatures, la valeur de 0,5 n'est valable que si l'armature est suffisamment raccordée et connectée à la disposition de mise à la terre.

Tableau B.5 – Facteur de réduction r_p en fonction des dispositions prises pour réduire les conséquences d'un incendie

Dispositions	r_p
Pas de disposition	1
Une des dispositions suivantes: extincteurs, installations d'extinction fixes déclenchées manuellement[a], installations manuelles d'alarme, prises d'eau, compartiments étanches, voies d'évacuation protégées	0,5
Une des dispositions suivantes: installations d'extinction fixes déclenchées automatiquement, installations d'alarme automatiques[b]	0,2

NOTE Ces dispositions ne sont valables que si elles sont disponibles et opérationnelles au moment où un phénomène de foudre survient. En cas de doute, la valeur r_p = 1 est suggérée. Dans certains pays, il n'est pas possible d'utiliser d'autres valeurs que r_p = 1, sauf si un SPF est prévu.

[a] Ces dispositions ne sont efficaces que si elles sont mises en œuvre par des personnes formées à cet effet et aptes à les appliquer.

[b] Seulement si elles sont protégées contre les surtensions ou d'autres dommages et si les pompiers peuvent intervenir en moins de 10 min.

Les dispositions prises pour réduire les conséquences d'un incendie, comme cela est décrit dans le Tableau B.5, n'empêchent pas la survenue d'un incendie dû à la foudre. Si des mesures d'atténuation des incendies sont utilisées dans le calcul du risque de foudre (r_p différent de 1), il convient d'en informer l'utilisateur. Si l'utilisateur n'en est pas informé, il convient d'appliquer r_p = 1.

Dans les zones avec risque d'explosion, r_p = 1 dans tous les cas, sauf si des dispositions sont prises pour s'assurer qu'une explosion ne peut pas se produire à la suite d'un incendie dans la zone explosive.

Dans les zones où se trouvent des batteries lithium-ion, il convient d'appliquer r_p = 1. Un faible volume de telles batteries peut être ignoré (un ordinateur portable, par exemple).

Tableau B.6 – Facteur de réduction r_f en fonction du risque d'incendie ou d'explosion de la structure

Risque	Niveau de risque	r_f
Explosion	Zones 0, 20 et explosif solide	1
	Zones 1, 21	10^{-1}
	Zones 2, 22	10^{-3}
Incendie	Élevé	10^{-1}
	Ordinaire	10^{-2}
	Faible	10^{-3}
Explosion ou incendie	Aucun	0
NOTE Des exemples de charges calorifiques pour différents types de structures peuvent être consultés dans d'autres documents, par exemple l'EN 1991-1-2 [12].		

NOTE 1 Dans le cas d'une structure avec possibilité d'explosion, les valeurs de r_f correspondent aux valeurs suggérées représentatives du cas le plus défavorable pour les calculs de la protection contre la foudre en l'absence de données d'entrée communiquées par le propriétaire de l'installation ou toute autre source appropriée. Dans la mesure où la probabilité de conditions dangereuses et les conséquences d'un incendie peuvent varier d'un site à l'autre, l'application des définitions des Zones 1 et 21 et des Zones 2 et 22 d'autres principes issus de l'IEC 60079 et de la série ISO/IEC 80079 permettrait de déterminer ces valeurs à partir des données d'entrée communiquées par les propriétaires d'installations ou toutes autres sources appropriées pour l'application considérée. Les normes et codes applicables à l'application constituent des exemples de sources appropriées.

NOTE 2 En présence de différentes conditions, le cas le plus défavorable est utilisé.

NOTE 3 Il peut être admis par hypothèse que les structures qui présentent un risque d'incendie élevé sont des structures en matériaux combustibles, des structures dont le toit est en matériaux combustibles ou des structures qui ont une charge calorifique spécifique supérieure à 800 MJ/m^2.

NOTE 4 Il peut être admis par hypothèse que les structures qui présentent un risque d'incendie ordinaire sont des structures qui ont une charge calorifique spécifique comprise entre 800 MJ/m2 et 400 MJ/m^2.

NOTE 5 Il peut être admis par hypothèse que les structures qui présentent un faible risque d'incendie sont des structures qui ont une charge calorifique spécifique inférieure à 400 MJ/m^2 ou des structures qui ne contiennent qu'une faible quantité de matériaux combustibles.

NOTE 6 La charge calorifique spécifique est le rapport entre l'énergie de la quantité totale de matériaux combustibles dans une structure et la surface globale de la structure.

NOTE 7 Pour les besoins du présent document, les structures associées à des zones dangereuses ou à des matériaux explosifs solides ne sont par hypothèse pas des structures avec risque d'explosion si l'une des conditions suivantes est remplie:

– la durée de présence des substances explosives est inférieure à 0,1 h/an;

– le volume de l'atmosphère explosive engendre une zone d'étendue négligeable;

– la zone dangereuse ne peut pas être frappée directement par un éclair et l'étincelage dangereux dans la zone dangereuse est évité. Cette condition est remplie dans les cas suivants:

  Pour les zones dangereuses protégées par des abris métalliques, si l'abri formé par un dispositif de capture naturel agit en toute sécurité sans problème de perforation ou de point chaud, et si les réseaux internes à l'intérieur de l'abri, le cas échéant, sont protégés contre les surtensions afin d'éviter un étincelage dangereux.

  Pour les zones dangereuses situées dans des structures, si celles-ci sont à l'intérieur de structures protégées par un SPF ou de structures à armature continue en métal ou en béton armé qui agissent comme un SPF naturel, qui satisfont aux exigences d'équipotentialité de l'IEC 62305-3 et si les réseaux internes de la zone, le cas échéant, sont protégés contre les surtensions afin d'éviter un étincelage dangereux.

NOTE 8 Les définitions et critères associés aux zones dangereuses et aux zones d'étendue négligeable figurent dans l'IEC 60079-10-1 [3] et l'IEC 60079-10-2 [4].

B.5 Probabilité P_C qu'un impact sur une structure entraîne des défaillances des réseaux internes

Un système de protection par parafoudres coordonnés est approprié comme mesure de protection pour réduire P_C.

La probabilité P_C qu'un impact sur une structure entraîne des défaillances des réseaux internes est donnée par:

$$P_C = P_{SPD} \times C_{LD} \quad \text{(B.5)}$$

P_{SPD} dépend de la conformité du système de protection par parafoudres coordonnés à l'IEC 62305-4 et des caractéristiques des réseaux internes. Les valeurs de P_{SPD} sont indiquées dans le Tableau B.7 et dans le Tableau B.8;

C_{LD} est un facteur associé aux conditions de blindage, de mise à la terre et d'isolation de la ligne à laquelle est connecté le réseau interne. Les valeurs de C_{LD} sont données dans le Tableau B.9.

NOTE 1 Un système de protection par parafoudres coordonnés n'est efficace pour réduire P_C que dans les structures protégées par un SPF ou dans les structures à armature continue en métal ou en béton armé qui agit comme un SPF naturel, lorsque les exigences d'équipotentialité de l'IEC 62305-3 sont remplies, quelle que soit la classe de SPF.

NOTE 2 Si le toit est considéré comme une zone du bâtiment, les mesures de protection sont définies comme pour les autres zones. Si une protection contre les impacts directs est exigée, le matériel sur le toit est protégé par le SPF et les parafoudres sont conçus selon la source de dommages S1 (couplage résistif et couplage inductif) dans le Tableau B.7 ou dans le Tableau B.8 comme approche simple.

Tableau B.7 – Valeurs types de P_{SPD} pour les parafoudres sur le réseau basse tension qui servent de protection contre les sources de dommages S1, S2, S3, S4

NPF	Impacts directs et indirects sur la ligne				Impact à proximité de la structure		Impact sur la structure		Impact sur la structure	
	Source de dommages S3[a]		Source de dommages S4[a]		Source de dommages S2[a]		Source de dommages S1[a] (couplage inductif)		Source de dommages S1[b] (couplage résistif)	
	kA 10/350 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 10/350 µs	P_{SPD}
Absence de parafoudre		1		1		1		1		1
III à IV	5	0,05	0,3	0,05	0,1	0,05	5	0,05	12,5	0,05
II	7,5	0,02	0,45	0,02	0,15	0,02	7,5	0,02	18,75	0,02
I	10	0,01	0,6	0,01	0,2	0,01	10	0,01	25	0,01
Meilleur que le NPF I			2,5[c d]	10^{-4}	2,5[c]	10^{-4}				
			3,75[c d]	5×10^{-5}	3,75[c]	5×10^{-5}				
			5[c d]	10^{-5}	5[c]	10^{-5}				

NOTE 1 Le NPF nécessaire pour les parafoudres peut être différent du NPF du SPF.

NOTE 2 Pour les lignes blindées, la valeur des courants peut être divisée par deux.

[a] Pour obtenir des informations sur les valeurs de courant et les conditions spécifiques, voir l'IEC 62305-1:2024, Tableau E.1.

[b] Les valeurs de courant se réfèrent à une seule ligne de service (n = 1) à conducteurs trois phases + neutre (n' = 4); facteur de répartition k_e = 0,5. Pour plus d'informations, voir l'IEC 62305-1:2024, Article E.2.

[c] Parafoudre d'utilisation courante.

[d] Les valeurs de S4 dans le Tableau E.1 de l'IEC 62305-1:2024 définies pour NPF I à IV sont indiquées dans les lignes "meilleur que le NPF I" du présent tableau.

Tableau B.8 – Valeurs types de P_{SPD} pour les parafoudres sur le réseau de communication qui servent de protection contre les sources de dommages S1, S2, S3, S4

NPF	Impacts directs et indirects sur la ligne				Impact à proximité de la structure		Impact sur la structure		Impact sur la structure	
	Source de dommages S3[a]		Source de dommages S4[a]		Source de dommages S2[a e]		Source de dommages S1[a d] (couplage inductif)		Source de dommages S1[b] (couplage résistif)	
	kA 10/350 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 10/350 µs	P_{SPD}
Absence de parafoudre		1		1		1		1		1
III à IV	1	0,05	0,3	0,05	0,1	0,05	5	0,05	1,25[f]	0,05
II	1,5	0,02	0,45	0,02	0,15	0,02	7,5	0,02	1 875[f]	0,02
I	2	0,01	0,6	0,01	0,2	0,01	10	0,01	2,5[f]	0,01
Meilleur que le NPF I			2,5[c]	10^{-4}	2,5[c]	10^{-4}				
			3,75[c]	5×10^{-5}	3,75[c]	5×10^{-5}				
			5[c]	10^{-5}	5[c]	10^{-5}				

NOTE 1 Le NPF nécessaire pour les parafoudres peut être différent du NPF du SPF.

NOTE 2 Voir la Recommandation UIT-T K.67 [13] pour plus d'informations.

NOTE 3 Valeurs pour les lignes aériennes non blindées. Pour les lignes enterrées, les valeurs des courants peuvent être divisées par deux. Pour les lignes blindées, les valeurs des courants peuvent être divisées par deux.

[a] Pour obtenir des informations sur les valeurs de courant et les conditions spécifiques, voir l'IEC 62305-1:2024, Tableau E.2.

[b] Des informations plus précises sont données dans l'Article E.2 de l'IEC 62305-1:2024.

[c] Parafoudre d'utilisation courante.

[d] L'acheminement dans les conducteurs en boucle et leur distance par rapport au courant induit compromet les valeurs des surintensités prévues. Les valeurs du Tableau E.2 de l'IEC 62305-1:2024 font référence à des conducteurs en boucle court-circuités et non blindés avec différents acheminements dans de grands bâtiments (zone de boucle de l'ordre de 50 m^2, largeur = 0,5 m), à 1 m de distance par rapport à la paroi de la structure, dans une structure non blindée (k_C = 1). Pour des caractéristiques de boucle et de structure différentes, il convient de multiplier les valeurs par les facteurs K_{S1}, K_{S2}, K_{S3} (voir l'Article B.6).

[e] L'acheminement dans les conducteurs en boucle et leur distance par rapport au courant induit compromet les valeurs des surintensités prévues. Les valeurs du Tableau E.2 de l'IEC 62305-1:2024 font référence à des conducteurs en boucle court-circuités et non blindés avec différents acheminements (zone de boucle de l'ordre de 50 m^2, largeur = 0,5 m), à 350 m de distance par rapport au coup de foudre, dans une structure non blindée. Pour des caractéristiques de boucle et de structure différentes, il convient de multiplier les valeurs par les facteurs K_{S1}, K_{S2}, K_{S3} (voir l'Article B.6).

[f] Des informations plus précises sont données dans l'Article E.2 de l'IEC 62305-1:2024.

Les valeurs de probabilité P_{SPD} données dans le Tableau B.7 et dans le Tableau B.8 se réfèrent au cas où P_{Up} est négligeable par rapport à P_{Q}. Dans ce cas, $P_{SPD} = P_{Q}$. Les valeurs de P_{SPD} données dans le Tableau B.7 et dans le Tableau B.8 peuvent être obtenues au moyen d'un système comportant deux SPD. Pour certaines applications, l'installation de deux SPD peut ne pas être possible. Il est nécessaire de comparer le niveau de protection U_{p} et les paramètres de courant de décharge I_{imp} afin d'évaluer l'efficacité d'un système de parafoudres.

Des valeurs de probabilité P_{SPD} autres que celles indiquées dans le Tableau B.7 et dans le Tableau B.8 peuvent être utilisées si elles sont suffisantes pour réduire le risque R et la fréquence des dommages F au-dessous des valeurs tolérables.

NOTE 3 Les caractéristiques de la ligne en amont du système de SPD et du circuit interne en aval de ce système ont une forte influence sur la valeur de la probabilité P_{SPD} qu'un appareil protégé par un système de SPD soit endommagé. L'indisponibilité d'informations quant au choix approprié d'un système de parafoudres dont la probabilité P_{Up} est négligeable représente un problème complexe. Les règles simplifiées données à titre de recommandation générale à l'Annexe C de l'IEC 62305-4:2024 peuvent être utilisées comme première approximation. Dans ce cas, les valeurs de P_{SPD} obtenues sont supérieures à celles indiquées dans le Tableau B.7 et dans le Tableau B.8.

NOTE 4 Des informations complémentaires sur le choix d'un système SPD qui donne la probabilité exigée P_{SPD} peuvent être fournies après une étude approfondie.

NOTE 5 Les valeurs indiquées dans le Tableau B.7 et dans le Tableau B.8 s'appliquent aux cas courants. Les valeurs de P_{SPD} fondées sur une analyse plus approfondie peuvent être déterminées selon l'Annexe D.

Tableau B.9 – Valeurs des facteurs C_{LD} et C_{LI} en fonction des conditions de blindage, de mise à la terre et d'isolation

Type de ligne extérieure	Connexion à l'entrée	C_{LD}	C_{LI}
Ligne aérienne non blindée	Non définie	1	1
Ligne enterrée non blindée	Non définie	1	1
Ligne de puissance à neutre mis à la terre en plusieurs emplacements	Aucun	1	0,2
Ligne enterrée blindée (de puissance ou de communication)	Blindage non relié à la borne d'équipotentialité à laquelle le matériel est connecté	1	0,3
Ligne aérienne blindée (de puissance ou de communication)	Blindage non relié à la borne d'équipotentialité à laquelle le matériel est connecté	1	0,1
Ligne enterrée blindée (de puissance ou de communication)	Blindage relié à la borne d'équipotentialité à laquelle le matériel est connecté	1	0
Ligne aérienne blindée (de puissance ou de communication)	Blindage relié à la borne d'équipotentialité à laquelle le matériel est connecté	1	0
Câble de protection contre la foudre ou câblage dans des conduits ou canalisations métalliques de câble de protection contre la foudre	Blindage relié à la borne d'équipotentialité à laquelle le matériel est connecté	0	0
Pas de ligne extérieure ou ligne optique	Pas de connexion à des lignes métalliques extérieures	0	0
Tout type	Connexion à une interface d'isolement selon l'IEC 62305-4[a]	0	0

[a] Pour ce matériel, les valeurs de C_{LD} et C_{LI} sont indiquées dans le présent tableau en fonction du type de ligne extérieure et de connexion à l'entrée. $C_{LD} = 0$ uniquement si l'interface d'isolement est protégée par un parafoudre ou s'il est démontré par des essais que la tenue aux chocs de l'interface d'isolement est appropriée. Dans le cas contraire, $C_{LD} = 1$. Voir aussi la Note 5.

NOTE 6 Une interface d'isolement fait partie d'un réseau interne et sa probabilité de défaillance peut être évaluée en fonction de sa tension de tenue. Un parafoudre qui protège l'interface d'isolement, s'il est fourni, protège même le matériel en aval lorsque le réseau interne entre l'interface d'isolement et le matériel est blindé. Lorsque le réseau interne n'est pas blindé et que la tension induite dans cette boucle, calculée selon le NPF exigé, est supérieure à la tension de choc assignée du matériel, un parafoudre supplémentaire peut être utilisé pour protéger le matériel en aval.

NOTE 7 Dans l'évaluation de la probabilité P_C, les valeurs de C_{LD} données dans le Tableau B.9 se réfèrent aux réseaux internes blindés. La valeur de C_{LD} d'un réseau interne non blindé qui n'est pas connecté à des lignes extérieures ou à des lignes optiques, ou qui est connecté à des lignes extérieures qui comportent des câbles de protection contre la foudre ou à des systèmes qui comportent des câblages dans des conduits ou canalisations métalliques de câble de protection contre la foudre, reliés à la borne d'équipotentialité à laquelle le matériel est connecté, est égale à la probabilité selon laquelle la tension induite U_I est inférieure ou égale à la tension de choc assignée U_w du réseau interne ($U_I \leq U_w$). Pour l'évaluation de la tension induite U_i, voir l'IEC 62305-4:2024, Annexes A et H. Dans les autres cas, il est admis par hypothèse que $C_{LD} = 1$.

B.6 Probabilité P_M qu'un impact à proximité d'une structure entraîne des défaillances des réseaux internes

Un SPF maillé, des écrans, des précautions de cheminement, une tension de tenue améliorée, des interfaces d'isolement et des systèmes de protection par parafoudres coordonnés sont appropriés comme mesures de protection pour réduire P_M.

La probabilité P_M de défaillance des réseaux internes due à un impact à proximité d'une structure dépend des MPF adoptées (voir l'IEC 62305-4).

Si aucun système de protection par parafoudres coordonnés conforme aux exigences de l'IEC 62305-4 n'est prévu, la valeur de P_M est égale à la valeur de P_{MS}.

Si un système de protection par parafoudres coordonnés conforme à l'IEC 62305-4 est prévu, la valeur de P_M est donnée par:

$$P_M = P_{SPD} \times P_{MS} \quad \text{(B.6)}$$

Pour les réseaux internes dont les matériels ne satisfont pas aux normes de produits applicables en matière de résistivité ou de niveau de tension de tenue, il convient de formuler l'hypothèse $P_M = 1$.

P_{SPD} dépend du système de protection par parafoudres coordonnés, de la surface de boucle du circuit du parafoudre et de l'appareil à protéger. Les valeurs de P_{SPD} sont indiquées dans le Tableau B.7 et dans le Tableau B.8.

NOTE 2 En raison des très faibles valeurs de charge prévisible qui circulent dans le parafoudre par rapport à ce à quoi un parafoudre habituel choisi peut résister, P_{SPD} est la probabilité que la valeur de la tension résiduelle dépasse le niveau de protection exigé qui correspond au courant qui circule dans le parafoudre (P_{Up}); cette probabilité dépend de la surface de boucle A du circuit du parafoudre et de l'appareil, et de la tension de choc assignée U_W de l'appareil à protéger. Des règles simplifiées sont données à titre de recommandation générale dans l'IEC 62305-4:2024, Annexe C.

Les valeurs de P_{MS} sont obtenues à partir du produit:

$$P_{MS} = (K_{S1} \times K_{S2} \times K_{S3})^2 \quad \text{(B.7)}$$

où

K_{S1} prend en compte l'efficacité de l'écran de la structure, du SPF ou d'autres écrans à la frontière de la ZPF 0/1;

K_{S2} prend en compte l'efficacité des écrans internes de la structure à la frontière de la ZPF X/Y (X > 0, Y > 1);

K_{S3} prend en compte les caractéristiques du câblage interne (voir le Tableau B.10).

NOTE 3 Dans l'Équation (B.6), K_{S4} (qui était lié à la tension de tenue aux chocs du réseau à protéger dans les éditions précédentes du présent document) est égal à 1, car la tension de tenue est déjà prise en compte dans le calcul de N_M.

NOTE 4 $K_{S3} = S/50$,

où

$S = w \times l$ est la surface de boucle;

w (m) est la largeur du circuit interne;

l (m) est la longueur du circuit interne.

Dans une ZPF, à une distance de sécurité de l'écran de limite au moins égale à la largeur de maille w_m, les facteurs K_{S1} et K_{S2} pour le SPF ou pour les blindages spatiaux maillés peuvent être évalués comme suit:

$$K_{S1} = 0{,}12 \times w_{m1} \tag{B.8}$$

$$K_{S2} = 0{,}12 \times w_{m2} \tag{B.9}$$

où w_{m1} (m) et w_{m2} (m) sont les largeurs de maille du blindage spatial maillé ou des conducteurs de descente maillés de type SPF, ou encore la distance de séparation entre les colonnes métalliques de la structure ou entre les armatures en béton armé qui font office de SPF naturel.

Pour les blindages électromagnétiques métalliques continus d'une épaisseur supérieure ou égale à 0,1 mm, $K_{S1} = K_{S2} = 10^{-4}$.

NOTE 5 Lorsqu'il est prévu un réseau d'équipotentialité maillé conforme à l'IEC 62305-4, les valeurs de K_{S1} et K_{S2} peuvent être divisées par deux.

Si une boucle d'induction est active à proximité des conducteurs blindés à la frontière d'une ZPF, à une distance du blindage plus faible que la distance de sécurité, les valeurs de K_{S1} et K_{S2} sont plus élevées. Par exemple, pour les distances comprises entre 0,1 w_m et 0,2 w_m par rapport au blindage, il convient de doubler les valeurs de K_{S1} et K_{S2}.

Pour une cascade de ZPF, la valeur finale K_{S2} est le produit des valeurs correspondantes K_{S2} de chaque ZPF.

NOTE 6 La valeur maximale de K_{S1} et de K_{S2} est limitée à 1.

Tableau B.10 – Valeur du facteur K_{S3} en fonction du câblage interne

Type de câblage interne	K_{S3} [a]
Câble non blindé – Pas de précaution de cheminement afin d'éviter des boucles[b]	1
Câble non blindé – Précaution de cheminement afin d'éviter des boucles de grande taille[c]	0,5
Câble non blindé – Précaution d'acheminement afin d'éviter des boucles de grande taille[d]	0,2
Câble non blindé – Précaution d'acheminement afin d'éviter des boucles[e]	0,01
Câbles blindés et câbles acheminés par des conduits métalliques[f]	0,000 1

[a] Données relatives à des circuits de 100 m de longueur. Pour les circuits plus courts, les valeurs de K_{S3} peuvent être réduites proportionnellement.

[b] Conducteurs en boucle avec différents acheminements (espacement entre conducteurs sous tension et conducteur PE ≥ 0,5 m) dans de grands bâtiments (surface de boucle de l'ordre de 50 m^2).

[c] Conducteurs en boucle acheminés dans le même conduit (espacement entre conducteurs sous tension et conducteur PE ≤ 0,25 m) ou conducteurs en boucle avec différents acheminements dans de petits bâtiments (surface de boucle de l'ordre de 25 m^2).

[d] Conducteurs en boucle acheminés dans le même conduit (espacement entre conducteurs sous tension et conducteur PE ≤ 0,1 m) ou conducteurs en boucle avec différents acheminements dans de petits bâtiments (surface de boucle de l'ordre de 10 m^2).

[e] Conducteurs en boucle acheminés dans le même câble (espacement entre conducteurs sous tension et conducteur PE de l'ordre de 0,005 m) (surface de boucle de l'ordre de 0,5 m^2).

[f] Blindages et conduits métalliques reliés à une borne d'équipotentialité aux deux extrémités, et matériel connecté à la même borne d'équipotentialité.

B.7 Probabilité P_U qu'un impact sur une ligne entraîne des dommages dus à des tensions de contact

Les valeurs de probabilité P_U qu'un impact sur une ligne entraîne des dommages dus à des tensions de contact à l'intérieur de la structure dépendent des caractéristiques du blindage de la ligne, de la tension de tenue aux chocs des réseaux internes connectés à la ligne, des mesures de protection telles que les restrictions physiques ou les panneaux d'avertissement et des interfaces d'isolement ou des parafoudres prévus pour le réseau d'équipotentialité à l'entrée de la ligne conformément à l'IEC 62305-3.

NOTE 1 Un système de protection par parafoudres coordonnés conforme à l'IEC 62305-4 n'est pas nécessaire pour réduire P_U. Dans ce cas, des SPD conformes à l'IEC 62305-3 sont suffisants.

Les valeurs de P_U sont données par:

$$P_U = P_{am} \times P_{EB} \times P_{LD} \times P_{TWS} \times C_{LD} \times r_t \qquad \text{(B.10)}$$

où

P_{am} dépend des mesures de protection contre les tensions de contact, telles que restrictions physiques ou panneaux d'avertissement. Les valeurs de P_{am} sont données dans le Tableau B.1;

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

NOTE 2 L'objet d'un message d'alerte créé par un TWS est d'assurer une évacuation immédiate et complète de la zone exposée. Si cette évacuation n'est pas assurée ou si aucun TWS n'est prévu, ou si le fabricant ne déclare pas le FTWR, il est admis par hypothèse que $P_{TWS} = 1$ (voir aussi l'IEC 62305-1:2024, 7.1 pour les restrictions d'application d'un TWS).

NOTE 3 La déconnexion est une option qui peut être utilisée dans le cadre d'une évaluation au cas par cas, compte tenu de la tension générée en l'absence de protection contre les tensions de choc. La déconnexion peut être valable pour les chocs en provenance des lignes (directs ou induits). Voir l'IEC 62305-1 pour plus d'informations.

P_{LD} est la probabilité de défaillances des réseaux internes dues à un impact sur la ligne connectée en fonction des caractéristiques de la ligne. Les valeurs de P_{LD} sont données dans le Tableau B.11 et dans le Tableau B.12;

NOTE 4 Les valeurs de P_{LD} peuvent être calculées à l'aide des équations suivantes:

$P_{LD} = P(I)$

$I = U_w/(4 \times R_s \times \sqrt{\rho} \times 10^{-3})$

où

I est le courant de crête des premiers coups de foudre positif et négatif (kA);

R_s est la résistance par unité de longueur de la gaine (Ω/km);

ρ est la résistivité du sol (Ω · m).

P_{EB} dépend de la liaison équipotentielle conforme à l'IEC 62305-3. Les valeurs de P_{EB} sont indiquées dans le Tableau B.13;

NOTE 5 $P_{EB} = P_Q$

C_{LD} est un facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne. Les valeurs de C_{LD} sont données dans le Tableau B.9;

r_t est le facteur de réduction en fonction du type de surface du sol ou du plancher. Les valeurs de r_t sont données dans le Tableau B.2.

NOTE 6 Lorsqu'un ou plusieurs SPD conformes à l'IEC 62305-3 sont prévus pour la liaison équipotentielle à l'entrée de la ligne, la mise à la terre et l'équipotentialité réalisées conformément à l'IEC 62305-4 peuvent améliorer la protection.

Tableau B.11 – Valeur de la probabilité P_{LD} en fonction de la résistance R_S de l'écran du câble et de la tension de tenue aux chocs U_W du matériel

Conditions de cheminement, de blindage et de mise à la terre		Tension de tenue U_W en kV							
		0,35	0,5	1	1,5	2,5	4	6	12
		P_{LD}							
Ligne aérienne ou enterrée, non blindée ou blindée, dont le blindage n'est pas relié à la borne d'équipotentialité à laquelle le matériel est connecté		1	1	1	1	1	1	1	1
Câble blindé aérien ou enterré, dont le blindage est relié à la borne d'équipotentialité à laquelle le matériel est connecté	5 Ω/km < R_S ≤ 20 Ω/km	1	1	1	1	0,95	0,9	0,8	0,4
	1 Ω/km < R_S ≤ 5 Ω/km	1	1	0,9	0,8	0,6	0,3	0,1	0,02
	R_S ≤ 1 Ω/km	1	0,85	0,6	0,4	0,2	0,04	0,02	0,005

Tableau B.12 – Valeur de la probabilité P_{LD} en fonction de la résistance R_S de l'écran du câble et de la tension de tenue aux chocs supérieure U_W du matériel

Conditions de cheminement, de blindage et de mise à la terre		Tension de tenue U_W en kV					
		16	20	40	60	75	95
		P_{LD}					
Ligne aérienne ou enterrée, non blindée ou blindée, dont le blindage n'est pas relié à la borne d'équipotentialité à laquelle le matériel est connecté		1	1	1	1	1	1
Câble blindé aérien ou enterré, dont le blindage est relié à la borne d'équipotentialité à laquelle le matériel est connecté	5 Ω/km < R_S ≤ 20 Ω/km	0,3	0,15	0,03	0,01	0,007	0,005
	1 Ω/km < R_S ≤ 5 Ω/km	0,01	0,007	0,001 5	0,001	4×10^{-4}	2×10^{-4}
	R_S ≤ 1 Ω/km	0,002	0,001 5	4×10^{-4}	$1,5 \times 10^{-4}$	10^{-4}	$0,7 \times 10^{-4}$

NOTE 7 En zone suburbaine et urbaine, une ligne de puissance BT utilise généralement un câble non blindé enterré tandis qu'une ligne de communication utilise un câble blindé enterré (avec un nombre minimal de 20 conducteurs, une résistance de blindage de 5 Ω/km et un diamètre du fil de cuivre de 0,6 mm). Dans les zones rurales, une ligne de puissance BT et une ligne de communication utilisent chacune un câble non blindé aérien (diamètre du fil de cuivre: 1 mm). Une ligne de puissance HT enterrée utilise généralement un câble blindé de résistance de blindage de l'ordre de 1 Ω/km à 5 Ω/km. Les informations fournies par la présente note peuvent être améliorées après une étude plus approfondie.

NOTE 8 Des valeurs inférieures à celles indiquées dans le Tableau B.11 et dans le Tableau B.12 peuvent être attribuées à la probabilité P_{LD} lorsque l'écran de la ligne est relié aux deux extrémités au même système de mise à la terre.

Tableau B.13 – Valeurs types de probabilité P_{EB} qui correspondent au NPF pour lequel le parafoudre est conçu pour protéger contre la source de dommages S3

NPF	Lignes de puissance kA 10/350 µs	Lignes de communication kA 10/350 µs	P_{EB}
Absence de parafoudre			1
III à IV	5	1	0,05
II	7,5	1,5	0,02
I	10	2	0,01
NOTE Pour obtenir des informations sur les valeurs de courant et les conditions spécifiques, voir l'IEC 62305-1:2024, Tableaux E.1 et E.2.			

NOTE 9 Des valeurs de P_{EB} inférieures à celles du Tableau B.13 sont possibles si les valeurs de I_{imp} et de I_n pour lesquelles les parafoudres sont conçus sont supérieures à celles qui sont exigées pour le NPF I.

B.8 Probabilité P_V qu'un impact sur une ligne entraîne des dommages physiques par incendie ou explosion

Les valeurs de probabilité P_V qu'un impact sur une ligne qui entre dans la structure entraîne des dommages physiques par incendie ou explosion dépendent des caractéristiques du blindage de la ligne, de la tension de tenue aux chocs des réseaux internes connectés à la ligne et des interfaces d'isolement ou des parafoudres prévus pour le réseau d'équipotentialité

NOTE 1 Un système de protection par parafoudres coordonnés conforme à l'IEC 62305-4 n'est pas nécessaire pour réduire P_V. Dans ce cas, des SPD conformes à l'IEC 62305-3 sont suffisants.

La valeur de P_V est donnée par:

$$P_V = P_{EB} \times P_{LD} \times P_{TWS} \times C_{LD} \times r_f \times r_p \tag{B.11}$$

où

P_{LD} est la probabilité de défaillances des réseaux internes dues à un impact sur la ligne connectée en fonction des caractéristiques de la ligne. Les valeurs de P_{LD} sont données dans le Tableau B.11 et dans le Tableau B.12;

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

NOTE 2 L'objet d'un message d'alerte créé par un TWS est d'assurer une évacuation immédiate et complète de la zone exposée. Si cette évacuation n'est pas assurée ou si aucun TWS n'est prévu, ou si le fabricant ne déclare pas le FTWR, il est admis par hypothèse que $P_{TWS} = 1$ (voir aussi l'IEC 62305-1:2024, 7.1 pour les restrictions d'application d'un TWS).

NOTE 3 La déconnexion est une option qui peut être utilisée dans le cadre d'une évaluation au cas par cas, compte tenu de la tension générée en l'absence de protection contre les tensions de choc. La déconnexion peut être valable pour les chocs en provenance des lignes (directs ou induits). Voir l'IEC 62305-1 pour plus d'informations.

P_{EB} dépend de la liaison équipotentielle conforme à l'IEC 62305-3. Les valeurs de P_{EB} sont données dans le Tableau B.13;

C_{LD} est un facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne. Les valeurs de C_{LD} sont données dans le Tableau B.9;

r_p est le facteur de réduction en fonction des dispositions prises pour réduire les conséquences d'un incendie. Les valeurs de r_p sont données dans le Tableau B.5;

r_f est le facteur de réduction en fonction du risque d'incendie ou d'explosion de la structure. Les valeurs de r_f sont données dans le Tableau B.6.

NOTE 4 Lorsqu'un coup de foudre frappe directement un service extérieur enterré, ce service peut être endommagé (dommages mécaniques, incendie, etc.) ou le câble peut être perforé en plusieurs endroits sur sa longueur, ce qui entraîne une détérioration sur le long terme (corrosion, par exemple). Ces dommages n'entrent pas dans le domaine d'application du présent document, qui examine uniquement l'incidence des services sur la structure à l'étude.

B.9 Probabilité P_W qu'un impact sur une ligne entraîne des défaillances des réseaux internes

Les valeurs de probabilité P_W qu'un impact sur une ligne qui entre dans la structure entraîne des défaillances des réseaux internes dépendent des caractéristiques du blindage de la ligne, de la tension de tenue aux chocs des réseaux internes connectés à la ligne et des interfaces d'isolement ou du système de protection par parafoudres coordonnés installé.

La valeur de P_W est donnée par:

$$P_W = P_{SPD} \times P_{TWS} \times P_{LD} \times C_{LD} \tag{B.12}$$

où

P_{SPD} dépend du système de protection par parafoudres coordonnés. Les valeurs de P_{SPD} sont données dans le Tableau B.7 et dans le Tableau B.8;

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

NOTE L'objet d'un message d'alerte créé par un TWS est d'assurer une évacuation immédiate et complète de la zone exposée. Si cette évacuation n'est pas assurée ou si aucun TWS n'est prévu, ou si le fabricant ne déclare pas le FTWR, il est admis par hypothèse que P_{TWS} = 1 (voir aussi l'IEC 62305-1:2024, 7.1 pour les restrictions d'application d'un TWS).

P_{LD} est la probabilité de défaillances des réseaux internes dues à un impact sur la ligne connectée en fonction des caractéristiques de la ligne. Les valeurs de P_{LD} sont données dans le Tableau B.11 et dans le Tableau B.12;

C_{LD} est un facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne. Les valeurs de C_{LD} sont données dans le Tableau B.9.

B.10 Probabilité P_Z qu'un impact à proximité d'une ligne entrante entraîne des défaillances des réseaux internes

Les valeurs de probabilité P_Z de défaillances des réseaux internes dues à un impact de foudre à proximité d'une ligne qui entre dans la structure dépendent des caractéristiques du blindage de la ligne et des interfaces d'isolement ou du système de protection par parafoudres coordonnés.

La valeur de P_Z est donnée par:

$$P_Z = P_{SPD} \times P_{TWS} \times C_{LI} \quad (B.13)$$

où

P_{SPD} dépend du système de protection par parafoudres coordonnés. Les valeurs de P_{SPD} sont données dans le Tableau B.7 et dans le Tableau B.8;

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

NOTE Si un TWS génère un message d'alerte, il n'est considéré comme efficace que si la déconnexion immédiate et complète des lignes de distribution extérieures est assurée. Si cette déconnexion n'est pas assurée ou si aucun TWS n'est prévu, il peut être admis par hypothèse que P_{TWS} = 1.

C_{LI} est un facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne. Les valeurs de C_{LI} sont données dans le Tableau B.9.

B.11 Probabilité P_P qu'une personne se trouve à un emplacement dangereux

La probabilité P_P qu'une personne se trouve à un emplacement dangereux dépend du temps t_z en heures par an pendant lequel les personnes sont présentes à cet emplacement dangereux:

$$P_P = t_z / 8\,760 \quad \text{(B.14)}$$

NOTE 1 Lorsque la valeur de t_z est inconnue, le rapport t_z/8 760 = 1.

NOTE 2 Lorsqu'un TWS permet l'évacuation temporaire d'une zone, t_z est multiplié par P_{TWS}.

B.12 Probabilité P_e qu'un matériel soit exposé à un événement provoquant des dommages

La probabilité P_e qu'un matériel non endommagé soit exposé à un événement qui provoque des dommages dépend du temps t_e en heures par année d'exposition du matériel à l'événement qui provoque des dommages.

$$P_e = t_e / 8\,760 \quad \text{(B.15)}$$

NOTE 1 Lorsque la valeur de t_e est inconnue, le rapport t_e/8 760 = 1.

NOTE 2 Dans le cas d'une zone explosive P_e peut être calculé en tant que $P_e = (t_e / 8\,760) \times r_f$ (r_f faisant référence au temps de présence maximal d'une atmosphère explosive divisé par 8 760) lors du calcul des composantes de risque. Cela ne s'applique pas au calcul de la fréquence des dommages, pour lequel seule la probabilité P_e est utilisée.

Annexe C
(informative)

Évaluation des pertes L_X

C.1 Généralités

L_X représente l'étendue moyenne des pertes dues à un événement dangereux, exprimée de manière relative par rapport à l'étendue maximale des pertes dans la zone à risque concernée de la structure à protéger.

Il convient de choisir les valeurs de L_X en fonction du type de structure, d'après sa fonction ou son contenu, ou les deux, de l'incidence sur la population de la perte de la structure (coûts des mesures d'urgence destinées à limiter les dommages, coûts entraînés par la perte de la structure et de la production, coûts de reconstruction et frais généraux que la société doit supporter, par exemple).

Il convient que les valeurs des pertes L_X soient estimées et fixées par le concepteur de la protection contre la foudre (ou par le propriétaire de la structure). Les valeurs moyennes des pertes L_X dans une structure données dans la présente Annexe C sont des valeurs types. D'autres valeurs peuvent être attribuées après une étude approfondie.

NOTE 1 Lorsque les dommages sur une structure dus à la foudre peuvent également impliquer des structures environnantes ou l'environnement (propagation d'un incendie, explosion, émissions chimiques ou radioactives, par exemple), une évaluation plus approfondie de L_X qui tient compte de ces pertes complémentaires peut être effectuée. Voir l'Annexe E.

NOTE 2 Il est rare que la perte de vies humaines ne soit pas du tout prise en compte, car du personnel est présent (au moins pendant certaines périodes) dans la plupart des structures (équipe de maintenance ou personnel de sécurité, par exemple). La présence humaine est presque constante dans d'autres structures telles que les édifices patrimoniaux nationaux ou les bâtiments de bureaux qui accueillent des employés et des visiteurs.

Il est souligné que le risque global relatif à une structure ou une application donnée est la plupart du temps constitué de plusieurs composantes de risque. Toutefois, pour calculer uniquement le risque de perte de vies humaines (blessures permanentes comprises), l'une ou les deux pertes relatives moyennes suivantes peuvent être fixées à la valeur 0:

L_{F2} est le rapport type moyen des dommages physiques provoqués par un incendie ou une explosion;

L_{O2} est le rapport type moyen des dommages physiques provoqués par une défaillance des réseaux internes.

De la même manière, pour calculer uniquement le risque en prenant pour hypothèse qu'il n'existe aucun risque de perte de vies humaines (blessures permanentes comprises), il est admis de fixer une ou plusieurs des pertes relatives moyennes suivantes à la valeur 0:

L_T est le rapport type moyen du nombre de personnes blessées par des tensions de contact et de pas;

L_D est le rapport type moyen du nombre de personnes blessées par un coup de foudre direct;

L_{F1} est le rapport type moyen du nombre de personnes blessées par un incendie ou une explosion;

L_{O1} est le rapport type moyen du nombre de personnes blessées par une défaillance des réseaux internes.

Les autres paramètres sont calculés en fonction de l'application.

C.2 Pertes relatives moyennes par événement dangereux

Les pertes L_X se réfèrent à l'étendue relative moyenne d'un type particulier de perte pour un événement dangereux dû à un impact de foudre, compte tenu de son étendue et de ses effets consécutifs.

La valeur des pertes L_X varie avec la cause du dommage (D_{1D}, D_{1T}, D_2 et D_3).

Il convient de déterminer les pertes L_X pour chaque zone à risque qui compose la structure ou pour la structure dans son ensemble.

Les valeurs des pertes L_X pour chaque zone à risque ou pour la structure peuvent être déterminées conformément au Tableau C.1 et au Tableau C.2.

Tableau C.1 – Valeurs des pertes pour chaque zone

Pertes types
$L_{AT} = L_{UT} = L_T$
$L_{AD} = L_D$
$L_{B1} = L_{V1} = L_{F1}$
$L_{B2} = L_{V2} = L_{F2}$
$L_{C1} = L_{M1} = L_{W1} = L_{Z1} = L_{O1}$
$L_{C2} = L_{M2} = L_{W2} = L_{Z2} = L_{O2}$

où

L_T est le rapport type moyen entre le nombre de personnes blessées par des tensions de contact et de pas du fait d'un événement dangereux et le nombre total de personnes dans la zone à risque ou la structure (voir le Tableau C.2);

L_D est le rapport type moyen entre le nombre de personnes blessées par un coup de foudre direct du fait d'un événement dangereux et le nombre total de personnes exposées dans la zone à risque ou la structure (voir le Tableau C.2);

L_{F1} est le rapport type moyen entre le nombre de personnes blessées par un incendie ou une explosion du fait d'un événement dangereux et le nombre total de personnes dans la zone à risque ou la structure (voir le Tableau C.2);

L_{F2} est le rapport type moyen entre les dommages physiques provoqués par un incendie ou une explosion du fait d'un événement dangereux et l'étendue maximale des dommages dans la zone à risque ou la structure (voir le Tableau C.2);

L_{O1} est le rapport type moyen entre le nombre de personnes blessées par une défaillance des réseaux internes du fait d'un événement dangereux et le nombre total de personnes dans la zone à risque ou la structure (voir le Tableau C.2);

L_{O2} est le rapport type moyen entre le nombre de dommages physiques provoqués par une défaillance des réseaux internes du fait d'un événement dangereux et l'étendue maximale des dommages dans la zone à risque ou la structure (voir le Tableau C.2).

NOTE 1 La valeur moyenne type des pertes peut être considérée comme la valeur moyenne des pertes dues à un événement dangereux qui provoque des dommages.

NOTE 2 En ce qui concerne L_{F1} ou L_{O1} et L_{F2} ou $L_{O2,}$ les niveaux de pertes peuvent être différents pour les personnes et pour la structure, ce qui signifie par exemple que pour un hôpital, la valeur L_{F1} peut être choisie dans la première ligne et la valeur L_{F2} dans la deuxième ligne du Tableau C.2, et inversement pour un musée.

NOTE 3 Il est admis d'utiliser $L_{F1} = L_{F2}$ en choisissant la valeur la plus élevée parmi les deux valeurs suggérées dans le Tableau C.2.

NOTE 4 L_T, L_D, L_{F1}, L_{O1} se réfèrent aux êtres humains, tandis que L_{F2} et L_{O2} se réfèrent aux structures et aux réseaux internes.

Tableau C.2 – Valeurs moyennes types de L_T, L_D, L_{F1}, L_{F2}, L_{O1} et L_{O2}

Type de structures ou de zones à risque	L_T	L_D	L_{F1}	L_{F2}	L_{O1}	L_{O2}
Structures ou zones à risque hautement essentielles ou à pertes très élevées[a]	10^{-2}	10^{-2} – 10^{-1}	10^{-2} – 2×10^{-1}	10^{-2} – 2×10^{-1}	10^{-3} – 10^{-2}	10^{-3} – 10^{-2}
Structures ou zones à risque essentielles ou à pertes élevées[b]			10^{-2} – 10^{-1}	10^{-2} – 10^{-1}	10^{-4} – 10^{-3}	10^{-4} – 10^{-3}
Structures ou zones à risque à pertes normales[c]			5×10^{-3} – 5×10^{-2}	5×10^{-3} – 5×10^{-2}	10^{-5} – 5×10^{-4} [e]	10^{-5} – 5×10^{-4} [e]
Structures ou zones à risque à faibles pertes[d]			2×10^{-3} – 2×10^{-2}	2×10^{-3} – 2×10^{-2}	10^{-5} – 10^{-4} [e]	10^{-5} – 10^{-4} [e]

[a] Telles que les structures ou les zones à risque avec risque d'explosion, les structures ou les zones à risque équipées de matériels de réanimation électriques ou autres structures, lorsque les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement (blocs opératoires et unités de soins intensifs dans les hôpitaux, par exemple).

[b] Telles que les structures ou les zones à risque liées aux personnes à mobilité réduite (bloc chambres dans les hôpitaux et les prisons, par exemple), les structures ou les zones à risque équipées de matériels essentiels à la réalisation de certains processus (salle de contrôle dans les structures industrielles, centrale électrique, centre de télécommunications, par exemple) et les structures ou les zones à risque avec un patrimoine culturel (musée, par exemple).

[c] Telles que les structures ouvertes au public (églises, hôtels, écoles, bureaux, bâtiments civils ouverts au public, installations de loisirs, supermarchés, par exemple).

[d] Telles que les bâtiments privés (immeuble d'appartements, ferme, par exemple).

[e] Cela s'applique uniquement lorsque le risque d'explosion ou les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement (par exemple, défaillance d'un matériel en raison d'un choc qui entraîne un rejet d'eau polluée dans la rivière ou lorsque l'incendie d'un matériel provoqué par un choc peut se propager dans la structure qui comporte des systèmes photovoltaïques ou des tensions en courant continu). En général, les structures ou les zones à risque qui présentent un tel risque sont classées comme étant à pertes très élevées ou à pertes élevées.

Une évaluation plus approfondie peut être nécessaire pour les valeurs de perte (L_{F1}, L_{F2}, L_{O1}, L_{O2}). Les valeurs les plus élevées pour les pertes indiquées dans le Tableau C.2 sont recommandées comme valeurs par défaut. D'autres valeurs peuvent être utilisées en s'appuyant sur une étude ou une expérience spécifique, en particulier si des valeurs inférieures aux valeurs minimales suggérées indiquées dans le Tableau C.2 sont utilisées.

Lorsque des dommages sur une structure dus à la foudre impliquent des structures environnantes ou l'environnement (par exemple, émissions chimiques ou radioactives), il convient de tenir compte des pertes complémentaires L_E pour évaluer les pertes totales (L_{BT} et L_{VT}).

$$L_{BT} = L_B + L_E \tag{C.1}$$

$$L_{VT} = L_V + L_E \tag{C.2}$$

où L_E est le rapport type moyen des pertes à l'extérieur de la structure du fait d'un événement dangereux sur l'étendue maximale des pertes dans la zone.

NOTE 5 L_E peut être évalué à l'aide de l'Annexe E.

NOTE 6 Des facteurs d'environnement peuvent également être pris en compte, s'ils sont traités comme une zone

Annexe D
(informative)

Évaluation de P_{SPD}

D.1 Généralités

Les valeurs indiquées dans le Tableau B.7 et dans le Tableau B.8 s'appliquent aux cas courants. Les valeurs de P_{SPD} fondées sur une analyse plus approfondie peuvent être déterminées selon la présente Annexe D.

La présente Annexe D explique comment le facteur de probabilité P_{SPD} d'un système de protection par parafoudres coordonnés peut être déterminé. Elle est destinée aux applications particulières dans lesquelles des valeurs de P_{SPD} autres que celles données dans le Tableau B.7 et dans le Tableau B.8 sont utilisées.

L'évaluation des valeurs de P_{SPD} par rapport aux différentes sources de dommages (à savoir S1, S2, S3 et S4) est réalisée au moyen de graphiques obtenus à l'aide d'un outil de calcul qui tient compte de l'effet de propagation entre le parafoudre et le matériel à protéger dans le circuit, de la tension induite dans ce même circuit et de la chute de tension dans les câbles de connexion du parafoudre.

Les graphiques font référence à des installations types et à la tension de choc assignée définie du matériel, c'est-à-dire 2,5 kV pour l'accès d'alimentation et 1,5 kV pour l'accès de signalisation d'un matériel. Cela fait office de recommandation quant à l'obtention de P_{SPD} pour d'autres cas à l'aide d'une méthode similaire.

La probabilité P_X que les mesures de protection réduisent les défaillances des réseaux internes dépend de la probabilité P_{SPD} d'un système de protection par parafoudres coordonnés.

Une défaillance d'un matériel protégé par un système de parafoudre peut se produire si:

a) la charge associée au courant I_{SPD} qui traverse le parafoudre dépasse la valeur tolérée par le parafoudre; ou
b) la tension de protection U_p dépasse le niveau de protection exigé U_{pr} du parafoudre afin de réduire la valeur de surtension à l'entrée du matériel à une valeur inférieure ou égale à la tension de choc assignée (U_w) du matériel.

La probabilité qu'une surtension n'endommage pas un matériel protégé par un système de protection par parafoudres coordonnés correspond à la probabilité qu'aucune des conditions (a) et (b) ne se produise.

Soit:

– P_Q: probabilité associée à la source de dommages à l'origine du courant décrit dans la condition (a);
– P_{Up}: probabilité associée à la source de dommages à l'origine de la condition (b).

Alors la probabilité P_{SPD} est donnée par:

$$P_{SPD} = 1 - (1 - P_Q) \times (1 - P_{Up}) \quad (D.1)$$

La probabilité P_{SPD} peut être simplifiée comme suit lorsque la probabilité P_Q se réfère aux premiers coups de foudre positif et négatif et que la probabilité P_{Up} se réfère aux impacts suivants des éclairs négatifs (cas le plus défavorable), et lorsque P_Q et P_{Up} sont nettement inférieures à 1:

$$P_{SPD} = P_Q + 0{,}9 \times P_{Up} \quad \text{(D.2)}$$

D.2 Valeurs de P_Q

D.2.1 Valeurs de probabilité des premiers coups de foudre négatif et positif

Les valeurs de probabilité de la charge peuvent être calculées avec les distributions log-normales de la charge du premier coup négatif de courte durée (P_{Q-}, moyenne m = 4,69 et dispersion σ = 0,383) et du premier coup positif de courte durée (P_{Q+}, moyenne m = 17,3, dispersion σ = 0,57) données à l'Annexe A de l'IEC 62305-1:2024, et en combinant les probabilités associées à une valeur de charge donnée, en estimant que 90 % des coups sont négatifs et que 10 % sont positifs. La Figure D.1 montre ce calcul (P_Q).

D.2.2 Source de dommages S1

D'après l'Annexe E de l'IEC 62305-1:2024, la charge de la source de dommages S1 à l'origine du courant de choc I_{imp} dans le parafoudre peut être calculée comme suit:

$$Q = I_{imp} \times n \times n' / k_e \quad \text{(D.3)}$$

où

k_e = $n' \times R_s / (n' \times R_s + R_c)$;

n est le nombre de services qui entrent dans la structure;

n' est le nombre de conducteurs du service concerné;

R_s est la résistance des blindages par unité de longueur du service blindé;

R_c est la résistance des conducteurs par unité de longueur du service;

k_e = 1 pour les conducteurs non blindés.

La valeur de la charge donnée par l'Équation (D.3) est utilisée pour lire, sur la Figure D.1, la probabilité P_Q du courant de choc I_{imp} du parafoudre.

EXEMPLE n = 2 services et n' = 4 conducteurs non blindés, I_{imp} = 10 kA, l'Équation (D.3) donne Q = 80 C et la probabilité P_Q = 0,012 peut être estimée sur la Figure D.1, tandis que lorsque n = 1, pour le même courant de 10 kA, l'Équation (D.3) donne Q = 40 °C et la probabilité P_Q = 0,033 peut être estimée sur la Figure D.1.

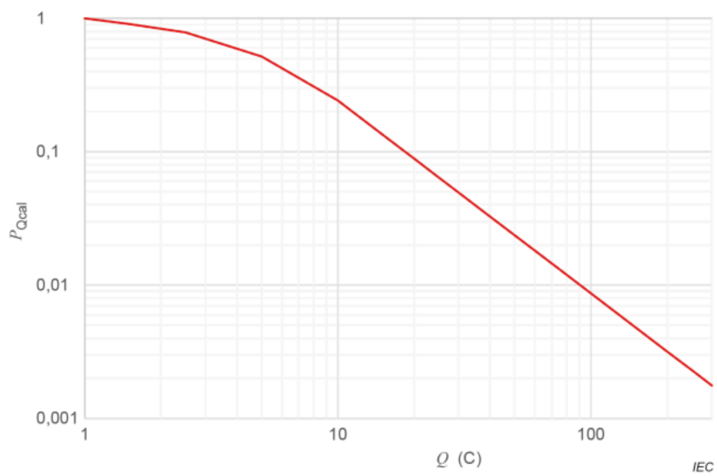


Figure D.1 – Probabilité de charge des premiers coups de foudre négatif et positif

D.2.3 Source de dommages S3

D'après l'Annexe E de l'IEC 62305-1:2024, la charge de la source de dommages S3 à l'origine du courant de choc I_{imp} dans le parafoudre peut être calculée comme suit:

$$Q = 2{,}5 \times n' \times I_{imp} / k_e \quad \text{(D.4)}$$

La valeur de la charge donnée par l'Équation (D.4) est utilisée pour lire, sur la Figure D.1, la probabilité P_Q du courant de choc I_{imp} du parafoudre.

EXEMPLE 1 n' = 2 conducteurs non blindés. Pour une ligne de communication, lorsque I_{imp} = 10 kA, l'Équation (D.4) donne Q = 50 C et la Figure D.1 donne P_{Q1} = 0,024. Pour une ligne de communication, lorsque I_{imp} = 2,5 kA, l'Équation (D.4) donne Q = 12,5 °C et la Figure D.1 donne P_Q = 0,175.

Dans le cas spécifique d'une ligne de communication à deux conducteurs (une paire), appelée ci-après "ligne de communication conventionnelle", il est courant que la longueur (l_1) de la section des deux conducteurs qui entre dans la structure soit égale à environ 10 % de la longueur totale (environ 4 km à 5 km de longueur totale, en règle générale), alors que les autres sections comportent de nombreuses paires, par exemple plusieurs centaines. Dans ce cas, la valeur de probabilité P_Q peut être évaluée spécifiquement en lien avec la section des deux conducteurs de la manière suivante:

$$P_Q = 0{,}1 \times P_{Q1} \quad \text{(D.5)}$$

où P_{Q1} est la probabilité de la charge donnée par l'Équation (D.4).

EXEMPLE 2 n' = 2 conducteurs non blindés. Pour une ligne de communication conventionnelle, lorsque I_{imp} = 1 kA, l'Équation (D.4) donne Q = 5 C et la Figure D.1 donne P_{Q1} = 0,52, et il est alors possible d'utiliser l'Équation (D.5) qui donne P_Q = 0,052.

D.2.4 Sources de dommages S2 et S4

D'après les valeurs de courant induit imputables à la source de dommages S2 ou S4 données dans le Tableau B.7 et dans le Tableau B.8 ou dans le Tableau E.2 et dans le Tableau E.3 de l'IEC 62305-1:2024, et étant donné que les parafoudres types utilisés ont une valeur de courant nominal de décharge I_n = 5 kA, les valeurs de probabilité P_{QM} et P_{QZ} sont d'environ 10^{-4} à 10^{-5} (quasiment négligeables).

D.3 Niveau de protection par parafoudre

D.3.1 Généralités

Pour les besoins du présent document, les parafoudres à coupure de tension et à limitation de tension sont définis comme suit:

– parafoudre à coupure de tension: parafoudre qui présente une impédance élevée en l'absence de choc, mais qui peut chuter rapidement en réponse à un choc de tension;
– parafoudre à limitation de tension: parafoudre qui présente une impédance élevée en l'absence de choc, mais qui diminue de manière continue avec un courant et une tension de choc croissants.

D.3.2 Source de dommages S1

D.3.2.1 Un parafoudre à limitation de tension

La valeur P_{Up} est obtenue pour un courant de 1 kA (comme P_{Up} concerne les coups suivants) et la tension résiduelle à 1 kA est appelée U_p' ci-après.

NOTE 1 Cette valeur peut être obtenue à partir de la fiche technique du parafoudre et, en cas d'indisponibilité, une approximation courante consiste à prendre la tension résiduelle à 5 kA et à la réduire de 200 V.

Les valeurs de P_{Up} en fonction de la tension résiduelle à 1 kA (U_p') sont indiquées sur la Figure D.2 pour différentes valeurs de paramètre k_{1i}, lorsque U_w = 2,5 kV, l_c = 0,5 m, $n \times n' \geq 8$ et $k_r > 1$.

où

k_{1i} =	$w \times k_c \times l_{eq} / d$;
l_{eq} =	$l_v + k_o \times l_o$ [m] (voir l'Annexe H de l'IEC 62305-4:2024);
l_v et l_o	sont les longueurs (m) de la boucle d'induction entre le parafoudre et le matériel qui sont respectivement parallèle et orthogonale aux conducteurs de descente;
l_o' =	$k_o \times l_o = [l_o \times w \times \ln(d + l_o) / \mathrm{d}]/[l_o \times \ln(d + w) / d]$ [m];
w	est la largeur (m) du réseau interne;
k_c	est la répartition du courant entre les conducteurs de descente;
d	est la distance (m) entre la boucle d'induction et le conducteur de descente le plus proche;
k_r	est le coefficient de réflexion;
k_0	est le rapport entre les tensions induites dans une boucle orthogonale et dans une boucle parallèle au conducteur de descente.

NOTE2 Selon le Tableau B.10, un câble blindé peut être représenté par w = 0,000 05 m.

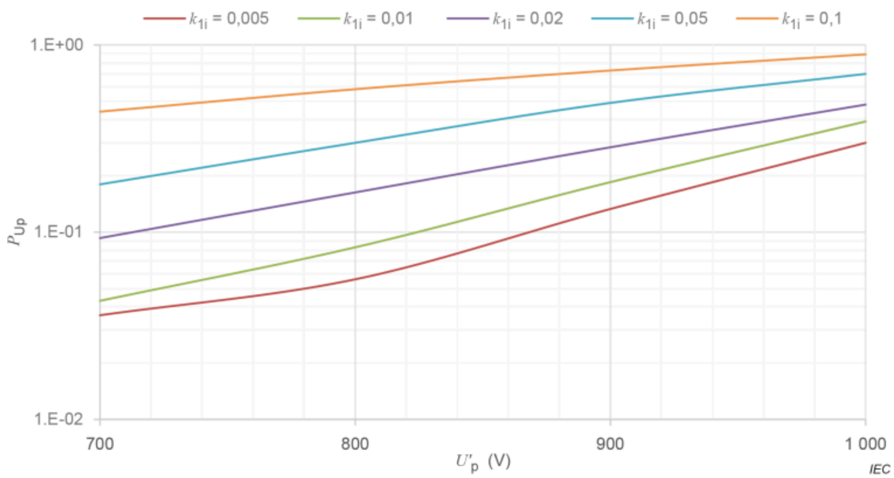


Figure D.2 – Probabilité P_{Up} en fonction de la tension résiduelle U_p' 1 kA du parafoudre

EXEMPLE n = 2, n' = 4, w = 0,005 m, k_c = 0,44, d = 1 m, l_v = 6 m, l_O = 44 m, l_c = 0,5 m, U_w = 2,5 kV. Dans ce cas, l_o' = 3,8 m, l_{eq} = 9,8 m, k_{1i} = 0,02 et, en choisissant un parafoudre à limitation de tension avec U_p' = 900 V, la Figure D.2 indique P_{Up} ≈ 0,3.

D.3.2.2 Un parafoudre à coupure de tension

Les parafoudres à coupure de tension sont généralement utilisés sur les lignes de communication à l'entrée de la structure et les niveaux de protection des tubes à décharge de gaz (GDT, *Gas Discharge Tubes*) sont habituellement de 700 V ou 550 V.

La Figure D.3 indique les valeurs de P_{Up} en fonction de différentes valeurs de paramètre k_{1i} pour les deux valeurs U_p habituelles des GDT, à savoir 700 V et 550 V, lorsque U_w = 1,5 kV, l_c = 0,5 m, k_r > 1, n' ≥ 20 conducteurs.

NOTE Les valeurs U_p sont données pour 1 kV/µs (voir l'EC 61643-21).

EXEMPLE n = 2, n' = 20, w = 0,1 m, k_c = 0,1, d = 2 m, l_v = 5 m, l_o = 21 m, l_c = 0,5 m, U_w = 1,5 kV. Dans ce cas, l_{eq} = 10 m, k_{1i} = 0,05 et, en choisissant un parafoudre à coupure de tension avec U_p = 550 V, la Figure D.3 indique P_{Up} ≈ 0,3.

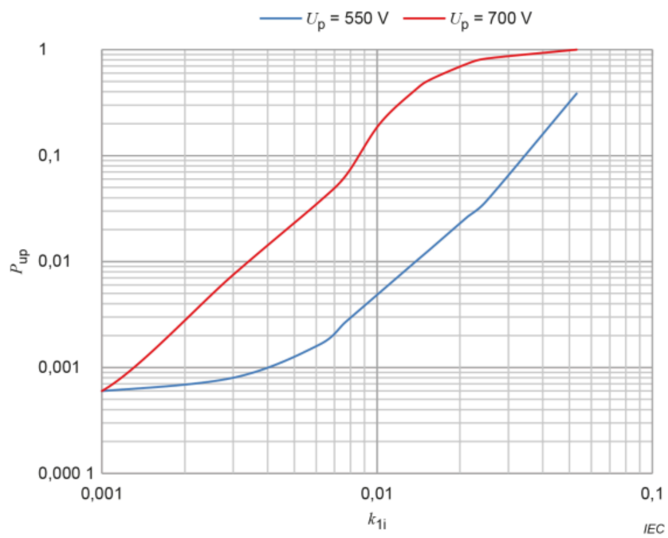


Figure D.3 – Probabilité P_{Up} en fonction de k_{1i}

D.3.2.3 Association d'un parafoudre à limitation de tension et d'un parafoudre à coupure de tension

Lorsque la puissance est répartie conformément au réseau TT, un parafoudre soumis à des essais de classe I peut être installé en amont du DDR. Cependant, la protection contre les contacts directs nécessite alors l'installation d'un parafoudre à coupure de tension entre les conducteurs de neutre et les conducteurs PE (N-PE) en complément des parafoudres à limitation de tension entre les conducteurs de neutre et les conducteurs de phases. Dans ce cas, il est admis de prendre pour hypothèse que la valeur de P_{Up} est la valeur la plus élevée de celles liées aux parafoudres à limitation de tension ou à coupure de tension.

En ce qui concerne les installations types où U_w = 2,5 kV et U_p = 1,5 kV du parafoudre à coupure de tension, une protection avec un parafoudre ne peut être obtenue que lorsque k_r = 1, c'est-à-dire lorsque la distance entre le parafoudre et le matériel à protéger est inférieure à 10 m et que l'endommagement du matériel n'entraîne aucun danger pour les personnes. Dans ce cas, la valeur de P_{Up} est celle liée au parafoudre à limitation de tension; les valeurs de P_{Up} pour une installation type sont indiquées dans le Tableau D.1 en fonction du niveau de protection à 1 kA du parafoudre à limitation de tension.

Tableau D.1 – Valeurs de P_{Up} du parafoudre à limitation de tension en cas d'association entre un parafoudre à limitation de tension et un parafoudre à coupure de tension

n	n'	w m	d m	L_v m	L_o m	L_a m	k_c	k_r	U_p' kV	P_{Up}
2	4	0,005	1	2	8	10	0,44	1	0,8	0,005
									1	0,007
									1,2	0,009
Lorsque w = 0,1 m, il convient de multiplier les valeurs de P_{Up} par un facteur de 60.										

Lorsque $k_r > 1$, un second parafoudre à limitation de tension doit être installé pour protéger l'accès d'alimentation du matériel.

D.3.2.4 Deux parafoudres à limitation de tension

Lorsque la valeur de probabilité P_{SPD} nécessaire ne peut pas être atteinte par un seul parafoudre à l'entrée du service dans la structure, il convient d'installer un second parafoudre à limitation de tension (SPD2), qui peut résister à une charge coordonnée avec celle du premier parafoudre.

La probabilité P_{SPD} de ce système de protection par parafoudres coordonnés est obtenue en additionnant la probabilité P_Q du premier parafoudre et la probabilité P_{Up} du second parafoudre selon l'Équation (D.2).

Ces valeurs de P_{Up} en fonction du niveau de protection à 1 kA (U_p') du SPD2 sont indiquées sur la Figure D.4 pour différentes valeurs de paramètre k_{1i}, lorsque U_w = 2,5 kV, l_c = 0,5 m, $n \times n' \geq 8$ et $k_r > 1$.

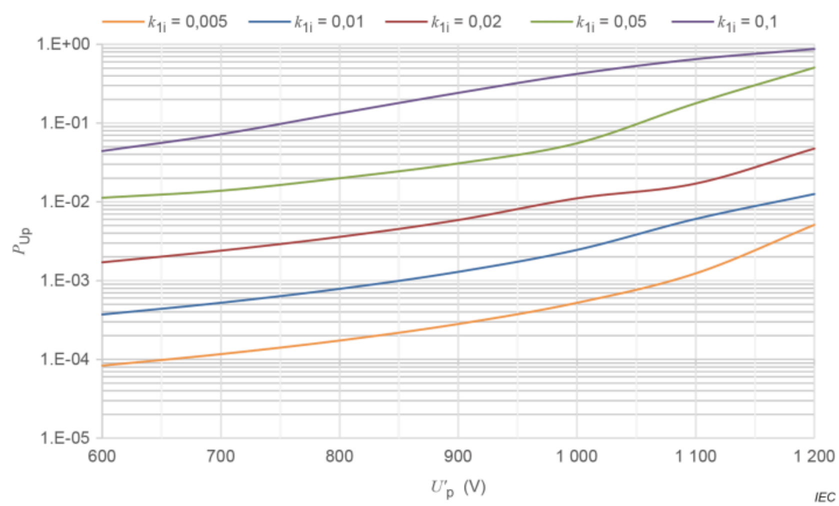


Figure D.4 – Probabilité P_{Up} en fonction de la tension résiduelle U_p' à 1 kA du SPD2

D.3.2.5 Deux parafoudres: un parafoudre à coupure de tension et un parafoudre à limitation de tension

Lorsque la valeur de probabilité P_{SPD} exigée ne peut pas être atteinte par un seul parafoudre à coupure de tension à l'entrée du service dans la structure, un second parafoudre à limitation de tension (SPD2), qui peut résister à une charge coordonnée avec celle du premier parafoudre, doit être installé.

La probabilité P_{SPD} de ce système de protection par parafoudres coordonnés est obtenue en additionnant la probabilité P_Q du premier parafoudre et la probabilité P_{Up} du second parafoudre selon l'Équation (D.2).

Ces valeurs de P_{Up} en fonction de la tension résiduelle à 1 kA (U_p') du SPD2 sont indiquées sur la Figure D.5 pour différentes valeurs de paramètre k_{1i}, lorsque U_w = 1,5 kV, l_c = 0,5 m,

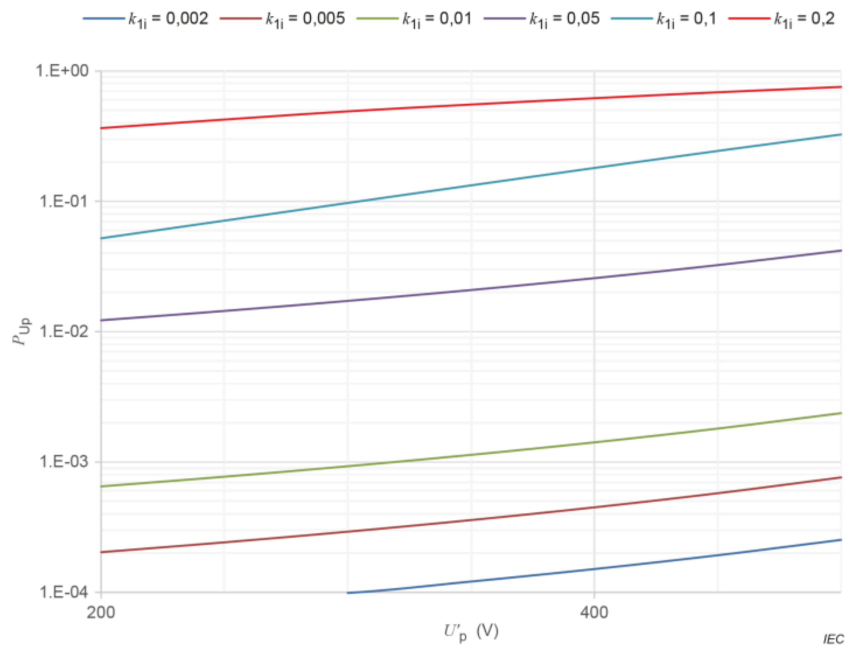


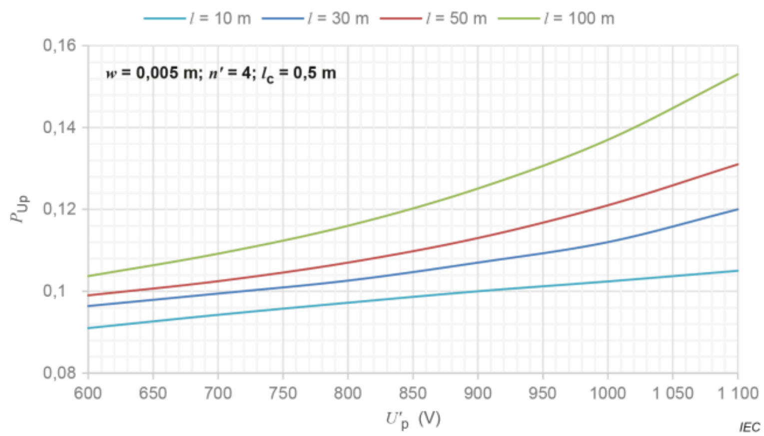
Figure D.5 – Probabilité P_{Up} en fonction de la tension résiduelle U_p' à 1 kA du SPD2

D.3.3 Source de dommages S3

D.3.3.1 Un parafoudre à limitation de tension

Les valeurs de P_{Up} en fonction de la tension résiduelle à 1 kA (U_p') sont indiquées sur la Figure D.6 pour différentes valeurs de longueur d'installation interne (l), lorsque U_w = 2,5 kV, l_c = 0,5 m, n'= 4, k_r > 1, w = 0,005 m et la longueur de ligne extérieure l_l est égale à 500 m.

EXEMPLE n' = 4, w = 0,1 m, l_v = 20 m, l_o = 80 m, l = 100 m, l_c = 0,5 m, U_w = 2,5 kV. En choisissant un parafoudre à limitation de tension avec U_p' = 900 V, la Figure D.6 indique P_{Up} ≈ 0,125 lorsque w = 0,005 m et que n' = 4 conducteurs. Néanmoins, la Note 3 de la Figure D.6 indique que cette valeur est multipliée par 1,4 lorsque w = 0,1 m, ce qui donne P_{Up} ≈ 0,125 × 1,4 = 0,175.



NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur 500/l_l.

NOTE 2 Lorsque n' = 2, les valeurs de P_{Up} sont multipliées par 1,4 (valeurs approximatives).

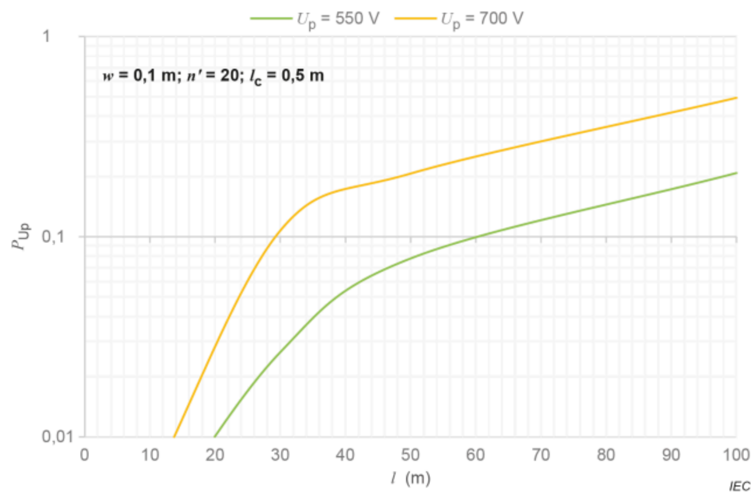
NOTE 3 Lorsque w = 0,1 m, les valeurs de P_{Up} sont multipliées par 1,4 (valeurs approximatives).

Figure D.6 – Probabilité P_{Up} en fonction de la tension résiduelle à 1 kA (U_p')

D.3.3.2 Un parafoudre à coupure de tension

Les valeurs de P_{Up} n fonction de différentes valeurs de longueur d'installation interne (l), pour deux niveaux de protection types des GDT, lorsque U_W = 1,5 kV, l_c = 0,5 m, w = 0,1 m, k_r > 1 et la longueur de ligne extérieure l_l = 500 m, sont indiquées sur la Figure D.7 pour n' = 20 conducteurs et sur la Figure D.8 pour n' = 2 conducteurs.

NOTE Il a été admis par hypothèse que la longueur interne du circuit est verticale à 20 % et horizontale à 80 % (par exemple, pour l = 30 m, le circuit est vertical sur 6 m et horizontal sur 24 m).

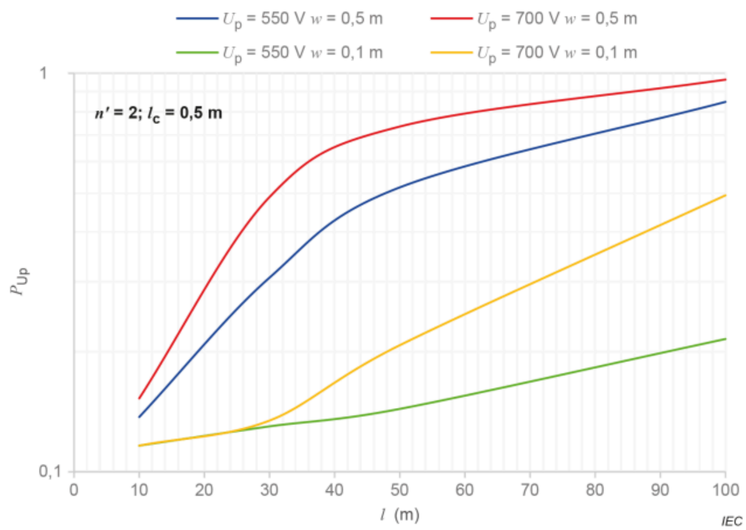


NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur 500/l_l.

NOTE 2 Lorsque w = 0,005 m et n' = 20, la valeur approximative de P_{Up} est de 0,003 4 avec l_l = 500 m pour les deux valeurs de U_p (550 V et 700 V). Cette valeur ne varie pas de manière significative lorsque l'installation interne est blindée.

Figure D.7 – Probabilité P_{Up} en fonction de différentes longueurs de circuit interne

EXEMPLE 2 conducteurs non blindés, longueur de ligne extérieure de 500 m, U_w = 1,5 kV, l_c = 0,5 m, w = 0,1 m et l = 30 m. Lorsque des GDT avec U_p = 550 V sont installés, la Figure D.8 indique P_{Up} = 0,134.



NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur 500/l_l.

NOTE 2 Lorsque w = 0,5 m et n' = 20, les valeurs de P_{Up} ne varient pas de manière significative.

NOTE 3 Lorsque w = 0,005 m et n' = 2, la valeur approximative de P_{Up} est de 0,12 pour l_l = 500 m et pour les deux valeurs de U_p (550 V et 700 V). Cette valeur ne varie pas de manière significative lorsque l'installation interne est blindée.

Figure D.8 – Probabilité P_{Up} en fonction de différentes longueurs de circuit interne

D.3.3.3 Parafoudre à limitation de tension et parafoudre à coupure de tension

Lorsque la puissance est répartie conformément au réseau TT, un parafoudre soumis à des essais de classe I peut être installé en amont du DDR. Cependant, la protection contre les contacts directs nécessite alors l'installation d'un parafoudre à coupure de tension entre les conducteurs de neutre et les conducteurs PE (N-PE) en complément des parafoudres à limitation de tension entre les conducteurs de neutre et les conducteurs de phases. Dans ce cas, il est admis de prendre pour hypothèse que la valeur de P_{Up} est la valeur la plus élevée de celles liées aux parafoudres à limitation de tension ou à coupure de tension.

En ce qui concerne les installations types où U_w = 2,5 kV et U_p = 1,5 kV du parafoudre à coupure de tension, une protection avec un seul parafoudre ne peut être obtenue que lorsque k_r = 1, c'est-à-dire lorsque la distance entre le parafoudre et le matériel à protéger est inférieure à 10 m et que l'endommagement du matériel n'entraîne aucun danger pour les personnes. Dans ce cas, la valeur de P_{Up} est celle liée au parafoudre à limitation de tension, et les valeurs de P_{Up} pour une installation type sont indiquées dans le Tableau D.2 en fonction du niveau de protection à 1 kA du parafoudre à limitation de tension.

Tableau D.2 – Valeurs de P_{Up} du parafoudre à limitation de tension

n'	w m	l_v m	l_o m	l m	k_r	U_p' kV	P_{Up}
4	0,1	2	8	10	1	0,8	0,05
						1	0,07
						1,2	0,1
Lorsque w = 0,005 m, il convient de multiplier les valeurs de P_{Up} par un facteur de 0,8.							

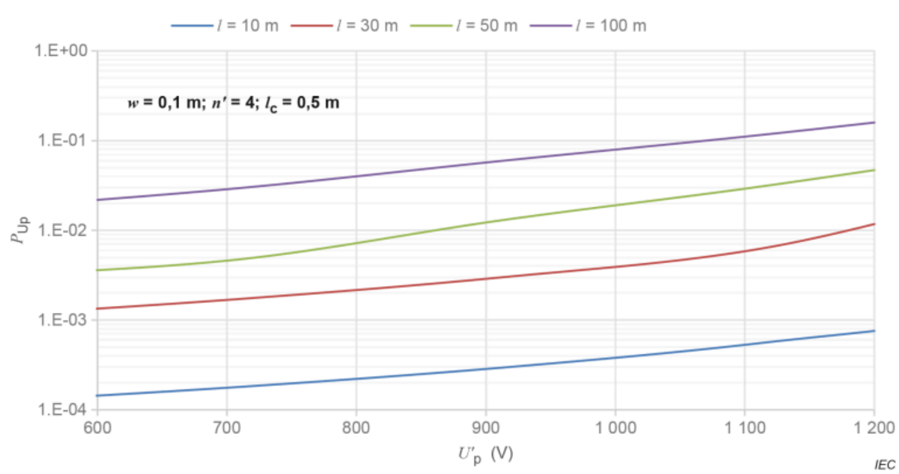
Lorsque k_r > 1, un second parafoudre à limitation de tension doit être installé pour protéger l'accès d'alimentation du matériel.

D.3.3.4 Deux parafoudres à limitation de tension

Lorsque la valeur de probabilité P_{SPD} nécessaire ne peut pas être atteinte par un seul parafoudre à l'entrée du service dans la structure, un second parafoudre à limitation de tension (SPD2), qui peut résister à une charge coordonnée avec celle du premier parafoudre, doit être installé.

La probabilité P_{SPD} de ce système de protection par parafoudres coordonnés est obtenue en additionnant la probabilité P_Q du premier parafoudre et la probabilité P_{Up} du second parafoudre selon l'Équation (D.2).

Ces valeurs de P_{Up} en fonction du niveau de protection à 1 kA (U_p') du SPD2 sont indiquées sur la Figure D.9 pour différentes longueurs d'installation interne (l), lorsque U_W = 2,5 kV, l_c = 0,5 m, w = 0,1 m, n' = 4 et k_r > 1.



NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur 500/l_l.

NOTE 2 Lorsque n' = 2, les valeurs de P_{Up} sont multipliées par 1,4 (valeurs approximatives).

NOTE 3 Lorsque w = 0,005 m, les valeurs de P_{Up} deviennent quasiment négligeables.

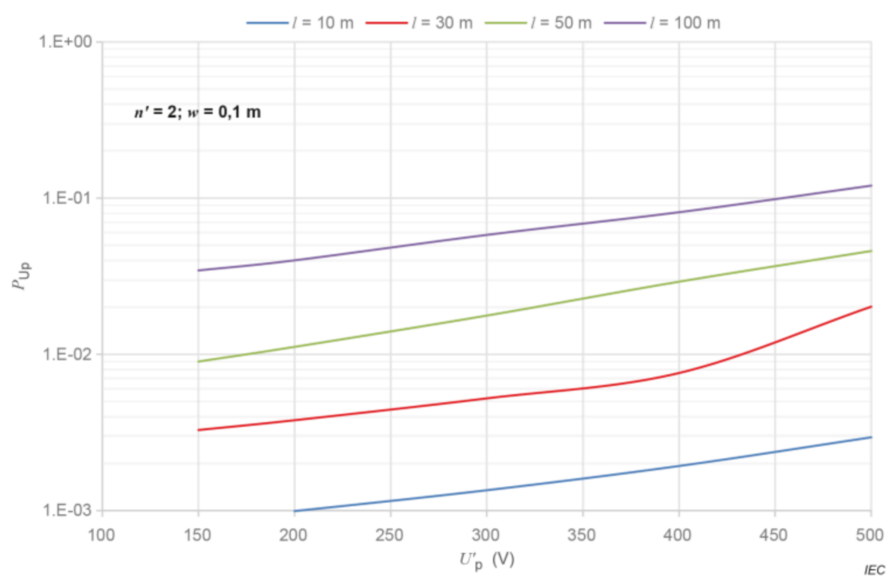
Figure D.9 – Probabilité P_{Up} en fonction de la tension résiduelle U_p' à 1 kA du SPD2

D.3.4 Parafoudres coordonnés en énergie: un parafoudre à coupure de tension et un parafoudre à limitation de tension en aval

Lorsque la valeur de probabilité P_{SPD} nécessaire ne peut pas être atteinte par un seul parafoudre à l'entrée du service dans la structure, un second parafoudre à limitation de tension (SPD2), qui peut résister à une charge coordonnée avec celle du premier parafoudre, doit être installé.

La probabilité P_{SPD} de ce système de protection par parafoudres coordonnés est obtenue en additionnant la probabilité P_Q du premier parafoudre et la probabilité P_{Up} du second parafoudre selon l'Équation (D.2).

Ces valeurs de P_{Up} en fonction du niveau de protection à 1 kA (U_p') du SPD2 sont indiquées sur la Figure D.10 pour différentes longueurs d'installation interne (l), lorsque U_W = 1,5 kV, l_c = 0,5 m, w = 0,1, n' = 2 et k_r > 1, sur la Figure D.11 lorsque w = 0,5 m avec n' = 2 ou 20 conducteurs et sur la Figure D.12 lorsque w = 0,1 et n' = 20 conducteurs.

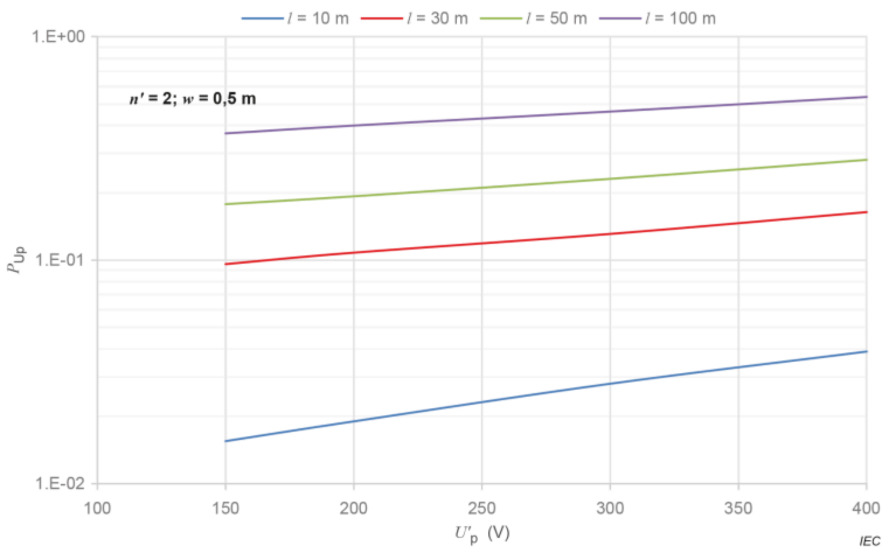


NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur 500/l_l.

NOTE 2 Lorsque n' = 4, les valeurs de P_{Up} sont multipliées par 0,7 (valeurs approximatives).

NOTE 3 Lorsque w = 0,005 m et n' = 2, les valeurs de P_{Up} deviennent quasiment négligeables (P_{Up} = 0,000 4 lorsque U_p' = 400 V et P_{Up} = 0,000 2 lorsque U_p' = 200 V pour une longueur maximale de 100 m).

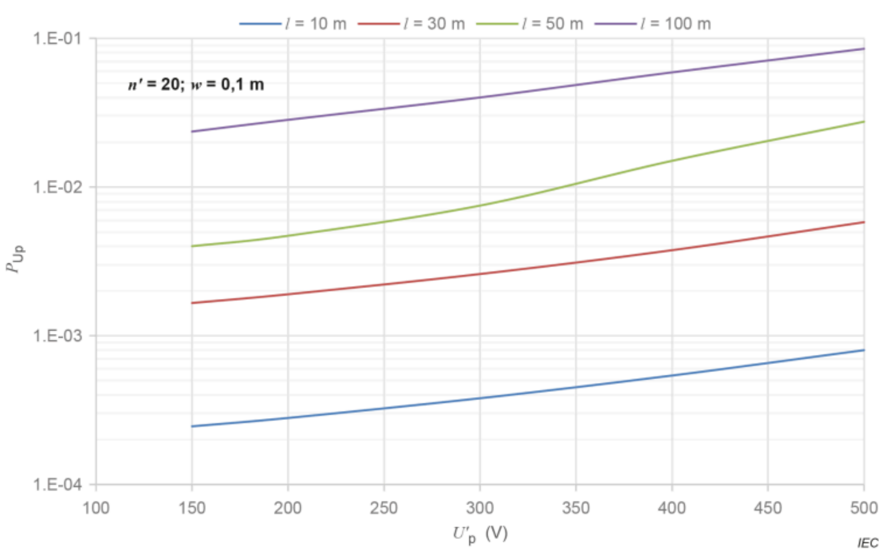
Figure D.10 – Probabilité P_{Up} en fonction de la surface de boucle interne pour n' = 2 et w = 0,1 m



NOTE 1 Pour d'autres longueurs de ligne extérieure (ll), les valeurs de P_{Up} sont multipliées par le facteur 500/ll.

NOTE 2 Des résultats similaires à ceux de la Figure D.11 peuvent être obtenus lorsque n' = 20 avec w = 0,5 m.

Figure D.11 – Probabilité P_{Up} en fonction de la surface de boucle interne pour n' = 2 et w = 0,5 m



NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur $500/l_l$.

NOTE 2 Lorsque w = 0,005 m, les valeurs de P_{Up} deviennent négligeables.

Figure D.12 – Probabilité P_{Up} en fonction de la surface de boucle interne pour n' = 20 et w = 0,1 m

D.4 Source de dommages S4

D.4.1 Un parafoudre à limitation de tension

La Figure D.13 représente l'évaluation de P_{Up} en fonction du niveau de protection à 1 kA (U_p') pour une surface de boucle interne différente en fonction du niveau de protection à 1 kA (U_p'), lorsque U_w = 2,5 kV, l_c = 0,5 m, n' = 4 et k_r est pratiquement égal à 1.

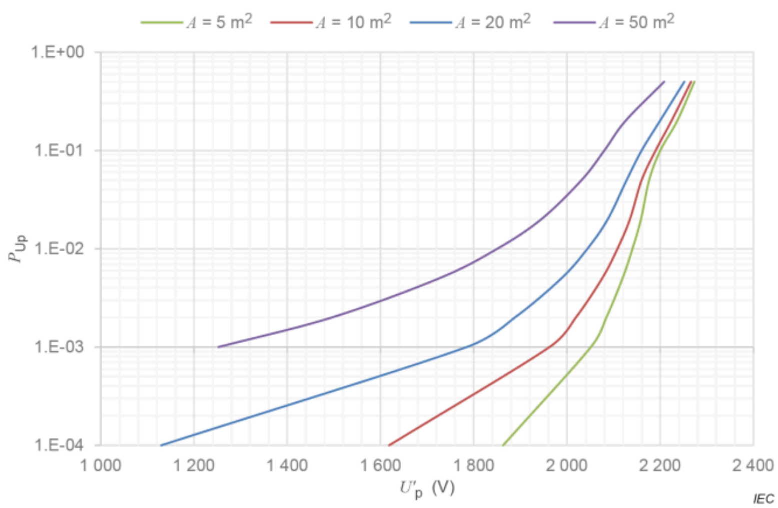


Figure D.13 – Probabilité P_{Up} en fonction du niveau de protection U_p' à 1 kA du parafoudre pour une surface de boucle interne différente

EXEMPLE La Figure D.13 indique que lorsque w = 0,1 m et l = 100 m, la probabilité P_{Up} est d'environ 0,000 1 pour U_p' = 1,6 kV. Un parafoudre soumis à des essais de classe II avec I_n = 5 kA et U_p' ≤ 1,6 kV donne une probabilité P_{SPD} = 0,000 1 par rapport à la source de dommages S4.

D.4.2 Un parafoudre à coupure de tension

Le parafoudre à coupure de tension est généralement utilisé sur les lignes de communication à l'entrée de la structure et les niveaux de protection des GDT sont habituellement de 700 V ou 550 V.

La Figure D.14 donne l'évaluation de P_{Up} en fonction d'une surface de boucle interne différente pour les deux valeurs U_p habituelles des GDT, à savoir 700 V et 550 V lorsque U_w = 1,5 kV, l_c = 0,5 m et k_r > 1.

EXEMPLE La Figure D.14 indique que lorsque U_w = 1,5 kV, w = 0,5 m et l = 100 m, la probabilité P_{Up} est d'environ 0,004 pour U_p' = 0,7 kV, et P_{Up} = 0,002 pour U_p' = 0,55 kV.

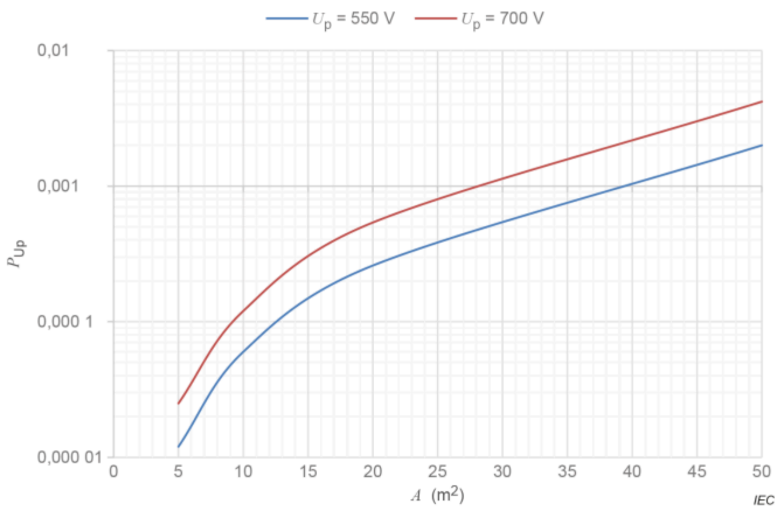


Figure D.14 – Probabilité P_{Up} en fonction d'une surface de boucle interne différente pour deux niveaux de protection types des GDT

D.5 Source de dommages S2

Un parafoudre installé à l'extrémité de la boucle interne, à partir du matériel à protéger, ne peut pas protéger ce matériel, car la tension induite dans la boucle entre le parafoudre et le matériel n'est pas réduite et est égale à la tension de choc assignée du matériel (U_w).

Une protection peut être obtenue en installant un parafoudre à limitation de tension plus près du matériel afin de réduire les dimensions de la boucle d'induction. Il peut même s'agir d'un second parafoudre coordonné avec le premier situé à l'extrémité à partir du matériel à protéger.

Lorsque les dimensions de la boucle d'origine, $S = w \times l$ (m^2), et les dimensions de la boucle entre ce parafoudre et le matériel, $S^* = w_1 \times l_1$ (m^2) sont définies, la valeur de P_{Up} est donnée par:

$$P_{Up} = [S^*/(U_w - –)]^2$$

où

U (V) est le niveau de protection U_p du parafoudre à coupure de tension ou la tension résiduelle à 1 kA (U_p') d'un parafoudre à limitation de tension.

Les valeurs de P_{Up} correspondent aux valeurs de P_{SPD}, car les valeurs de P_Q sont généralement négligeables lorsque le courant nominal de décharge I_n est égal ou supérieur à 2,5 kA.

Annexe E
(informative)

Étude approfondie des pertes complémentaires L_E liées à l'environnement

E.1 Généralités

La présente Annexe E est destinée aux applications particulières. Pour la plupart des structures, il n'est pas nécessaire de calculer un risque pour l'environnement, mais si nécessaire, il est possible d'utiliser la présente Annexe E comme recommandation.

L'Annexe E décrit une méthode simple qui consiste à définir les pertes complémentaires L_E pour prendre en compte les dommages sur une structure qui peuvent impliquer des structures environnantes ou l'environnement. S'il est nécessaire d'étudier de manière plus approfondie les dommages causés à une structure environnante ou à l'environnement, le concept suivant, décrit à l'Annexe E, peut être utilisé pour calculer la perte complémentaire L_E. Avec ce concept, l'incidence des différentes caractéristiques et conditions de la structure frappée par la foudre et de son environnement sur les pertes complémentaires subies par l'environnement peut être estimée de manière plus précise.

Les conditions suivantes sont valables:

– Les composantes de risque R_{AT}, R_{AD} et R_U ne sont pas prises en compte pour l'environnement, car elles ne s'appliquent qu'à la structure frappée par la foudre en soi;
– Les types de pertes suivants s'appliquent à l'environnement:
  L_1: pertes dues à des blessures sur des êtres humains dans l'environnement;
  L_2: pertes dues à des dommages physiques à l'environnement.

E.2 Calcul des composantes de risque

Les composantes de risque qui s'appliquent à l'environnement sont calculées d'après les équations indiquées dans le Tableau E.1.

Tableau E.1 – Composantes de risque pour différentes sources de dommages et différents types de pertes qui s'appliquent aux dommages à l'environnement

Type de perte	Source de dommages			
	S1 Impact de foudre sur une structure	**S2 Impact de foudre à proximité d'une structure**	**S3 Impact de foudre sur une ligne (entrante)**	**S4 Impact de foudre à proximité d'une ligne**
L_1 Blessures sur êtres vivants	R_{B1E} $= N_D \times P_B \times P_{PE} \times L_{B1E}$		R_{V1E} $= (N_L + N_{DJ}) \times P_V \times P_{PE} \times L_{V1E}$	
	R_{C1E} $= N_D \times P_C \times P_{PE} \times P_e \times L_{C1E}$ Voir la note de bas de page "a".	R_{M1E} $= N_M \times P_M \times P_{PE} \times P_e \times L_{M1E}$ Voir la note de bas de page "a".	R_{W1E} $= (N_L + N_{DJ}) \times P_W \times P_{PE} \times P_e \times L_{W1E}$ Voir la note de bas de page "a".	R_{Z1E} $= N_I \times P_Z \times P_{PE} \times P_e \times L_{Z1E}$ Voir la note de bas de page "a".
L_2 Dommages physiques	R_{B2E} $= N_D \times P_B \times L_{B2E}$		R_{V2E} $= (N_L + N_{DJ}) \times P_V \times L_{V2E}$	
	R_{C2E} $= N_D \times P_C \times P_e \times L_{C2E}$ Voir la note de bas de page "b".	R_{M2E} $= N_M \times P_M \times P_e \times L_{M2E}$ Voir la note de bas de page "b".	R_{W2E} $= (N_L + N_{DJ}) \times P_W \times P_e \times L_{W2E}$ Voir la note de bas de page "b".	R_{Z2E} $= N_I \times P_Z \times P_e \times L_{Z2E}$ Voir la note de bas de page "b".

[a] R_{C1E}, R_{M1E}, R_{W1E} et R_{Z1E} s'appliquent principalement aux structures avec risque d'explosion et pour les hôpitaux ou autres structures dans lesquelles des défaillances des réseaux internes entraînent des dangers mortels immédiats.

[b] R_{C2E}, R_{M2E}, R_{W2E} et R_{Z2E} s'appliquent principalement aux structures avec risque d'explosion.

où les relations générales sont données ci-dessous:

$$L_{B1E} = L_{V1E} = L_{F1E} \tag{E.1}$$

$$L_{C1E} = L_{M1E} = L_{W1E} = L_{Z1E} = L_{O1E} \tag{E.2}$$

$$P_{PE} = t_{zE} / 8\,760 \tag{E.3}$$

$$L_{B2E} = L_{V2E} = L_{F2E} \tag{E.4}$$

$$L_{C2E} = L_{M2E} = L_{W2E} = L_{Z2E} = L_{O2E} \tag{E.5}$$

où

L_{F1E} est le rapport type moyen entre le nombre de personnes blessées par un incendie ou une explosion du fait d'un événement dangereux et le nombre total de personnes dans la zone environnante (voir le Tableau E.3);

L_{O1E} est le rapport type moyen entre le nombre de personnes blessées par une défaillance des réseaux internes du fait d'un événement dangereux et le nombre total de personnes

L_{F2E} est le rapport type moyen entre les dommages physiques provoqués par un incendie ou une explosion du fait d'un événement dangereux et l'étendue maximale des dommages dans la zone environnante (voir le Tableau E.4);

L_{O2E} est le rapport type moyen entre les dommages physiques provoqués par une défaillance des réseaux internes du fait d'un événement dangereux et l'étendue maximale des dommages dans la zone environnante (voir le Tableau E.4);

t_{zE} est le temps de présence des personnes à un emplacement potentiellement dangereux dans la zone environnante (voir le Tableau E.2).

Tous ces paramètres sont fondés sur des scénarios et il convient de les évaluer de manière précise. Lorsqu'un scénario ne justifie pas une composante, il convient alors de considérer cette composante comme égale à zéro. Par exemple, si un choc induit à l'intérieur d'une structure ne peut pas générer de scénario qui entraîne lui-même des dommages sur des biens à l'extérieur de la structure, il convient de considérer L_{M2E} comme égal à 0.

Tous les autres paramètres donnés dans les équations du Tableau E.1 sont utilisés et calculés comme cela est décrit à l'Annexe A et à l'Annexe B et dans la partie principale du présent document.

Si les valeurs de t_{ZE} sont inconnues, il convient de prendre pour hypothèse t_{ZE}/8 760 = 1 lorsque des zones résidentielles constamment occupées par des personnes peuvent se trouver aux alentours de la structure.

Sinon, les valeurs suggérées dans le Tableau E.2 peuvent être utilisées. Ces valeurs peuvent être modifiées après une étude approfondie.

Tableau E.2 – Type de perte L1: Valeurs types suggérées pour la durée de présence de personnes t_{zE}/8 760 associée dans différents environnements, limitées selon le Tableau E.3

Type d'environnement	t_{zE}/8 760[a]
Site de travail	0,25
Site de travail avec plusieurs périodes d'activité	1,0
Structures ouvertes au public	0,5
Zones d'activités (industries et autres activités généralement non ouvertes au public)	0,75
Résidences	1
Routes	1
Voies ferrées	0,25
Voies fluviales	0,1
Voies piétonnes	0,75
Terrains ouverts et zones très peu fréquentées (champs, prairies, forêts, terrains vagues, marécages, etc.)	0,25
Zones peu fréquentées (jardins et zones horticoles, vignobles, zones de pêche, gares de triage, etc.)	0,25
Zones normalement ou souvent fréquentées (parkings, parcs, bains surveillés, terrains sportifs)	0,5
Cas particuliers (fréquentation sporadique)	0,1

[a] En cas d'environnements "mixtes" qui présentent plusieurs valeurs, il convient d'utiliser la valeur la plus élevée.

Pour L_{F1E} et L_{O1E}, les valeurs indiquées dans le Tableau E.3 sont des propositions. Des calculs plus précis peuvent être effectués. Lorsqu'il n'existe aucun risque pour les zones environnantes, il convient de prendre pour hypothèse $L_{F1E} = L_{O1E} = 0$.

Tableau E.3 – Type de perte L1: Valeurs moyennes types de L_{F1E} et L_{O1E} à l'extérieur de la structure

Valeurs de L_{F1E} et L_{O1E} Scénario	Risque environnemental – Qui reste à l'intérieur des clôtures du site		Risque environnemental – Qui s'étend à l'extérieur des clôtures du site	
	L_{F1E} [g]	L_{O1E} [g]	L_{F1E}	L_{O1E}
Explosion et surpression[a]	0,25	0,025	0,5	0,05
Flux thermique[b]	0,05	0,005	0,1	0,01
Fumées toxiques[c]	0,1	0,01	1,0	0,1
Pollution des sols[c]	0,1	0,01	0,5	0,05
Pollution des eaux[c]	0,25[d]	0,025	2,5	0,25
Matières radioactives[c e f]	0,5	0,05	5	0,5

[a] La surpression dépasse une valeur de 5 kPa.

[b] La puissance thermique par zone dépasse une valeur de 3 kW/m^2.

[c] Ces valeurs maximales peuvent être réduites en fonction de la quantité du polluant, du danger qu'il représente et de la sensibilité de l'environnement.

[d] Uniquement si la pollution peut atteindre la nappe phréatique, l'eau douce, la mer ou les océans.

[e] Il est possible que cette disposition ne s'applique pas lorsqu'une étude spécifique qui comprend tous les scénarios a été élaborée.

[f] Ne s'applique pas aux sources scellées utilisées par exemple dans les dispositifs de mesure ou le matériel médical.

[g] Dans le cas d'un TWS, les valeurs de L_{F1E} et L_{O1E} à l'intérieur des clôtures du site sont multipliées par $(1 - P_{TWS})$.

Pour L_{F2E} et L_{O2E}, les valeurs indiquées dans le Tableau E.4 sont des propositions. Des calculs plus précis peuvent être effectués. Lorsqu'il n'existe aucun risque pour les zones environnantes, il convient de prendre pour hypothèse $L_{F2E} = L_{O2E} = 0$.

Tableau E.4 – Type de perte L2: Valeurs moyennes types de L_{F2E} et L_{O2E} à l'extérieur de la structure

Scénario	Risque environnemental	
	L_{F2E}	L_{O2E}
Explosion et surpression[a]	0,5	0,05
Flux thermique[b]	0,1	0,01
Fumées toxiques[c]	0,5	0,05
Pollution des sols[c]	0,2	0,02
Pollution des eaux[c]	0,5[d]	0,05
Matières radioactives[c e f]	1	0,1

a La surpression dépasse une valeur de 14 kPa.

b La puissance thermique par zone dépasse une valeur de 8 kW/m².

c Ces valeurs maximales peuvent être réduites en fonction de la quantité du polluant, du danger qu'il représente et de la sensibilité de l'environnement.

d Uniquement si la pollution peut atteindre le lit d'eau, l'eau douce, la mer ou les océans.

e Il est possible que cette disposition ne s'applique pas lorsqu'une étude spécifique qui comprend tous les scénarios a été élaborée.

f Ne s'applique pas aux sources scellées utilisées par exemple dans les dispositifs de mesure ou le matériel médical.

Annexe F
(informative)

Études de cas

F.1 Généralités

La présente Annexe F fournit des études de cas qui portent sur une maison, un immeuble de bureaux et un hôpital en vue d'indiquer le risque et la fréquence des dommages:

– la façon de procéder à des calculs avec la valeur des paramètres et de déterminer la nécessité d'une protection;
– la contribution des différentes composantes à la valeur globale;
– l'effet des différentes mesures de protection pour réduire à la fois le risque et la fréquence des dommages.

NOTE La présente Annexe F fournit des hypothèses pour tous les cas. Elle est destinée à donner des informations sur l'évaluation des risques et des fréquences de dommages afin d'étayer les principes contenus dans le présent document. Il ne s'agit pas de traiter les aspects propres aux conditions rencontrées dans toutes les installations ou tous les réseaux.

Par souci de simplification, certains facteurs sont donnés comme suit:

$R_B = R_{B1} + R_{B2}$

$R_C = R_{C1} + R_{C2}$

$R_M = R_{M1} + R_{M2}$

$R_V = R_{V1} + R_{V2}$

$R_W = R_{W1} + R_{W2}$

$R_Z = R_{Z1} + R_{Z2}$

Dans les tableaux, le tiret (–) signifie "non applicable".

Les valeurs de risque et de fréquence calculées dans les tableaux sont fixées à 3 décimales. Les valeurs inférieures sont donc exprimées par ≈ 0.

En raison des valeurs arrondies utilisées pour le calcul, les résultats des valeurs calculées peuvent être légèrement différents.

F.2 Maison

F.2.1 Données et caractéristiques pertinentes

NOTE Dans cet exemple, les indices supplémentaires P, T et D, qui représentent respectivement les lignes de puissance, de communication et de données, ont été ajoutés aux paramètres existants.

La maison ne dispose d'aucune protection contre la foudre existante et est située dans une région plate sans structures environnantes. La densité de points d'impact au sol de la foudre est N_{SG} = 8 (nombre d'impacts par km^2 et par an). La maison est habitée durant six mois de l'année. L'hypothèse retenue est que personne ne se trouve à l'extérieur de la maison pendant un orage.

Cette maison est desservie par une ligne de puissance aérienne basse tension et une ligne téléphonique aérienne. Aucune partie conductrice externe n'est reliée à la maison.

Les données relatives aux lignes entrantes et aux réseaux internes connectés à ces lignes sont données dans le Tableau F.2 pour la ligne de puissance et dans le Tableau F.3 pour la ligne de communication. La dernière colonne indique les emplacements où les valeurs choisies peuvent être consultées ou le procédé utilisé pour déterminer une valeur. Dans le Tableau F.1, la source de données de LSS ne peut pas fournir la valeur de k, aussi la valeur par défaut de 2 est utilisée. La structure ne fournit aucune protection contre les IEMF, aussi la valeur par défaut de K_{S1} est choisie. Aucun système d'alerte aux orages (TWS) n'est utilisé dans la structure. Lorsqu'aucune justification ni aucune référence à des articles spécifiques n'est donnée, les valeurs ont été choisies à titre d'exemple.

Tableau F.1 – Maison: caractéristiques de l'environnement et de la structure

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Densité de points d'impact au sol de la foudre (nombre de points d'impact par km² et par an)		N_{SG}	8,0	
Facteur qui lie N_G à N_{SG}		k	2	Article A.1
Dimensions de la structure (m)		L, W, H	15, 20, 6	
Facteur d'emplacement de la structure	Structure isolée	C_D	1	Tableau A.1
Matériau de construction	Maçonnerie	P_S	1	Tableau B.4
Blindage de la structure	Aucun	K_{S1}	1	Article B.6
Facteur d'environnement	Rural	C_E	1	Tableau A.4
SPF	Aucun	P_{LPS}	1	Tableau B.3
TWS	Aucun	P_{TWS}	1	Article B.1

Tableau F.2 – Maison: ligne de puissance

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Longueur (m)[a]		L_L	1 000	Article A.4
Facteur d'installation	Aérien	C_{IP}	1	Tableau A.2
Facteur de type de ligne	Ligne BT	C_{TP}	1	Tableau A.3
Facteur d'environnement	Rural	C_{EP}	1	Tableau A.4
Blindage, mise à la terre, isolation	Aucun	C_{LDP}	1	Tableau B.9
		C_{LIP}	1	
Liaison équipotentielle	Aucun	P_{EBP}	1	Tableau B.13
Structure adjacente	Aucun	L_J, W_J, H_J	–	
Facteur d'emplacement de la structure	Aucun	C_{DJ}	–	Tableau A.1
Tension de tenue du réseau interne (kV)		U_{WP}	2,5	
Nombre de conducteurs	Conducteurs trois phases + neutre	n_P	4	Tableau B.7
	Paramètre résultant	P_{LDP}	1	Tableau B.11
Distance latérale pour $S2$ (m)	U_{WP} est supérieur à U_{WT}	r_{MP}	-	Non utilisée, voir l'Équation (A.8) et le Tableau F.3
Distance latérale pour $S4$ (m)		r_{IP}	384	$2\,000/U_{WP}^{1,8}$, voir l'Équation (A.12)

[a] La longueur L_L de la section de ligne étant inconnue, l'hypothèse retenue est L_L = 1 000 m (Article A.4).

Tableau F.3 – Maison: ligne de communication

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Longueur (m)		L_L	800	Article A.4
Facteur d'installation	Aérien	C_{IT}	1	Tableau A.2
Facteur de type de ligne	Ligne de communication	C_{TT}	1	Tableau A.3
Facteur d'environnement	Rural	C_{ET}	1	Tableau A.4
Blindage, mise à la terre, isolation	Aucun	C_{LDT}	1	Tableau B.8
		C_{LIT}	1	
Liaison équipotentielle	Aucun	P_{EBT}	1	Tableau B.13
Structure adjacente	Aucun	L_J, W_J, H_J	–	La baie de communication à l'autre extrémité de la ligne est de trop faibles dimensions pour être prise en compte
Facteur d'emplacement de la structure	Structure isolée	C_{DJ}	–	Tableau A.1
Tension de tenue du réseau interne (kV)		U_{WT}	1,5	
Nombre de conducteurs		n_T	2	Tableau B.8
	Paramètre résultant	P_{LDT}	1	Tableau B.11
Distance latérale pour S2 (m)	U_{WT} est inférieur à U_{WP}	r_{MT}	233	350/U_{WT}, voir l'Équation (A.8)
Distance latérale pour S4 (m)		r_{IT}	964	2 000/$U_{WT}^{1,8}$, voir l'Équation (A.12)

F.2.2 Calcul du nombre annuel prévisible d'événements dangereux

Les calculs sont donnés dans le Tableau F.4 pour les surfaces équivalentes d'exposition et dans le Tableau F.5 pour le nombre prévisible d'événements dangereux.

Tableau F.4 – Maison: surfaces équivalentes d'exposition de la structure et des lignes

	Symbole	Résultat m²	Référence
Structure	A_D	$2,58 \times 10^3$	A.2.1.2, Équation (A.3)
	A_M	$1,87 \times 10^5$	Article A.3, Équation (A.8)
Ligne de puissance	A_{LP}	$4,00 \times 10^4$	Article A.4, Équation (A.10)
	A_{IP}	$7,69 \times 10^5$	Article A.5, Équation (A.12)
Ligne de communication	A_{LT}	$3,20 \times 10^4$	Article A.4, Équation (A.10)
	A_{IT}	$1,54 \times 10^6$	Article A.5, Équation (A.12)

Tableau F.5 – Maison: nombre annuel prévisible d'événements dangereux

	Symbole	Résultat 1/an	Référence
Structure	N_D	$2,06 \times 10^{-2}$	A.2.4, Équation (A.5)
	N_M	$7,5 \times 10^{-1}$	Article A.3, Équation (A.7)
Ligne de puissance	N_{LP}	$3,2 \times 10^{-1}$	Article A.4, Équation (A.9)
	N_{IP}	3,07	Article A.5, Équation (A.11)
Ligne de communication	N_{LT}	$2,56 \times 10^{-1}$	Article A.4, Équation (A.9)
	N_{IT}	6,17	Article A.5, Équation (A.11)

F.2.3 Évaluation des risques

Il convient en premier lieu d'identifier les zones à risque qui peuvent composer la structure. Pour chaque zone à risque, le risque R et la fréquence des dommages F causés aux réseaux internes sont évalués.

Ceci entraîne:

a) la nécessité de déterminer le risque R et de le comparer au risque tolérable $R_T = 10^{-5}$ (7.3). Si nécessaire, il convient de choisir des mesures de protection adaptées pour atténuer ce risque.

   Les composantes de risque sont évaluées conformément au Tableau 3;

b) la nécessité de déterminer la fréquence de dommages F et de la comparer à la fréquence de dommages tolérable F_T (9.3). Dans le cas présent, la fréquence tolérable des dommages a été fixée par le propriétaire du bâtiment à la valeur $F_T = 10^{-1}$. Par conséquent, il convient de choisir des mesures de protection adaptées pour réduire cette fréquence des dommages, si nécessaire. Les composantes de la fréquence des dommages sont évaluées conformément au Tableau 4.

Dans cet exemple, seul le risque est calculé. La fréquence des dommages est traitée dans les autres exemples.

F.2.4 Définition des zones à risque dans la maison

Les principales zones à risque suivantes peuvent être définies comme suit:

Z_1 (extérieur du bâtiment);

Z_2 (intérieur du bâtiment) est définie en tenant compte des éléments suivants:

- les deux réseaux internes (de puissance et de communication) couvrent tout le bâtiment;
- il n'y a pas de blindages spatiaux;
- la structure constitue un compartiment unique à l'épreuve du feu;
- par hypothèse, les pertes sont constantes dans tout le bâtiment et correspondent aux valeurs moyennes types du Tableau C.2.

Les valeurs de durée de présence annuelle des personnes dans chacune des zones à risque et les composantes de risque à prendre en compte sont indiquées dans le Tableau F.6. Le temps passé à l'extérieur du bâtiment est si limité que pour les besoins de cet exemple, il est admis par hypothèse que personne ne se trouve à l'extérieur du bâtiment (Z_1 est donc ignorée).

Tableau F.6 – Maison: durée de présence des personnes et composantes de risque dans les zones à risque

Zone à risque	Durée de présence heures/année	Composantes de risque								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_2 (intérieur du bâtiment)	4 380	X		X			X	X		

Pour la zone Z_1, étant donné que personne ne se trouve à l'extérieur du bâtiment, le risque de choc qui frappe des personnes R_{AT} = 0. Par hypothèse également, il n'y a pas de réseaux électriques à l'extérieur du bâtiment et donc la fréquence des dommages F = 0.

Les paramètres définis pour la zone Z_2 sont indiqués dans le Tableau F.7.

Tableau F.7 – Maison: valeurs pour la zone Z_2 (intérieur du bâtiment)

Paramètre d'entrée		Commentaire	Symbole	Valeur	Référence
Type de plancher		Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)		Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée		Non applicable	P_o	0	Article B.3
Risque d'incendie		Faible	r_f	10^{-3}	Tableau B.6
Protection contre l'incendie		Aucun	r_p	1	Tableau B.5
Facteur relatif aux personnes dans la zone		t_z/8 760 = 4 380/8 760	P_P	0,5	Équation (B.14)
Facteur relatif aux matériels dans la zone		t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Blindage de la zone		Aucun	K_{S2}	1	Équation (B.9)
Réseau interne de puissance	Câblage interne	Conducteurs non blindés acheminés dans le même conduit	K_{S3P}	2×10^{-1}	Tableau B.10
	Facteur de tension de tenue (kV)		U_{WP}	2,5	
	Réseau SPD	Aucun	P_{SPD}	1	Tableau B.7
Réseau interne de communication	Câblage interne	Conducteurs non blindés avec différents acheminements	K_{S3T}	1	Tableau B.10
	Facteur de tension de tenue (kV)		U_{WT}	1,5	
	Réseau SPD	Aucun	P_{SPD}	1	Tableau B.8
Type de zone en fonction des pertes		Zone à faibles pertes	-	-	Tableau C.2

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	
	Personnes blessées par incendie	L_{F1}	2×10^{-2}	
	Dommages physiques causés par un incendie	L_{F2}	2×10^{-2}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	10^{-1}	

F.2.5 Appréciation du risque

Le risque R peut être exprimé selon l'Équation (1). Les composantes impliquées sont indiquées dans le Tableau F.6 et les valeurs de risque dans le Tableau F.8.

Tableau F.8 – Maison: risque pour la structure non protégée (valeurs × 10^{-5})

Symbole	Z_2
R_{AT}	≈ 0
R_B	0,062
R_U	0,003
R_V	1,728
R	1,793
R_T	1

Comme le risque R est supérieur à la valeur tolérable $R_T = 10^{-5}$, une protection contre la foudre de la structure est exigée pour atténuer le risque.

F.2.6 Risque – Choix de mesures de protection

Selon le Tableau F.8, la principale contribution à la valeur de risque est donnée par la composante R_V (impact sur des lignes) et réduire cette composante peut être suffisant pour faire passer le risque au-dessous du niveau tolérable.

Pour réduire le risque R à une valeur tolérable, il convient d'examiner les mesures de protection qui impliquent les composantes R_V. Des parafoudres de NPF IV installés sur les lignes de puissance et les lignes téléphoniques au point d'entrée dans la maison (liaison équipotentielle) constituent des mesures appropriées. D'après le Tableau F.7, ces mesures permettent de réduire la valeur de P_{EB} (en raison des parafoudres sur les lignes connectées) de 1 à 0,05 et les valeurs de P_V par le même facteur. L'insertion de ces valeurs dans les équations permet d'obtenir de nouvelles valeurs des composantes de risque, comme cela est indiqué dans le Tableau F.9, qui indique que le risque total se situe désormais au-dessous du niveau tolérable.

Tableau F.9 – Maison: composantes de risque pour la structure protégée (valeurs × 10^{-5})

Symbole	Z_2
R_{AT}	≈ 0
R_B	0,062
R_U	≈ 0
R_V	0,086
R	0,149
R_T	1

F.2.7 Conclusions

Le risque R peut être réduit au-dessous du niveau tolérable en installant un parafoudre soumis à un essai de classe I et de NPF IV pour les lignes de puissance et les lignes téléphoniques.

F.3 Bâtiment de bureaux

F.3.1 Données et caractéristiques pertinentes

La deuxième étude de cas concerne un immeuble de bureaux qui comporte des archives, des bureaux et un centre informatique.

Le bâtiment de bureaux est situé dans une région plate sans structures environnantes. La densité de points d'impact au sol de la foudre est N_{SG} = 4 (nombre d'impacts par km^2 et par an).

Le bâtiment de bureaux est alimenté par une ligne de puissance et une ligne de communication. En outre, une partie conductrice externe est reliée à la structure (canalisation d'eau). La ligne de communication externe est constituée d'un câble fibronique non métallique, tandis que la ligne de communication interne est une ligne non blindée en cuivre.

Les données relatives au bâtiment et à son environnement sont indiquées dans le Tableau F.10. Les données relatives aux lignes entrantes et aux réseaux internes connectés à ces lignes sont données dans le Tableau F.11 pour la ligne de puissance et dans le Tableau F.12 pour la ligne de communication.

Tableau F.10 – Bâtiment de bureaux: caractéristiques de l'environnement et de la structure

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Densité de points d'impact au sol de la foudre (nombre de points d'impact par km² et par an)		N_{SG}	4,0	
Facteur qui lie N_G à N_{SG}		k	2	Article A.1
Dimensions de la structure (m)		L, W, H	20, 40, 25	
Facteur d'emplacement de la structure	Structure isolée	C_D	1	Tableau A.1
Matériau de construction	Béton armé	P_S	0,5	Tableau B.4
Blindage de la structure	Aucun	K_{S1}	1	Équation (B.8)
Facteur d'environnement	Suburbain	C_E	0,5	Tableau A.4
SPF	Aucun	P_{LPS}	1	Tableau B.3
TWS	Aucun	P_{TWS}	1	Article B.1

Tableau F.11 – Bâtiment de bureaux: ligne de puissance

Paramètre d'entrée		Commentaire	Symbole	Valeur	Référence
Section HT	Longueur (m)		L_L	1 000	Article A.4
	Facteur d'installation	Enterrée	C_I	0,3	Tableau A.2
	Facteur de type de ligne	Ligne HT	C_T	0,2	Tableau A.3
	Facteur d'environnement	Suburbain	C_E	0,5	Tableau A.4
	Blindage de ligne (Ω/km)	Non blindée	R_S	–	
Section BT	Longueur (m)		L_L	100	
	Facteur d'installation	Enterrée	C_I	0,3	Tableau A.2
	Facteur de type de ligne	Ligne BT	C_T	1	Tableau A.3
	Facteur d'environnement	Suburbain	C_E	0,5	Tableau A.4
	Blindage de ligne (Ω/km)	Non blindée	R_S	–	
Blindage, mise à la terre, isolation		Aucun	C_{LD}	1	Tableau B.9
			C_{LI}	1	
Liaison équipotentielle		Aucun	P_{EB}	1	Tableau B.13
Structure adjacente		Aucun	L_J, W_J, H_J	–	La longueur de la ligne HT est de 1 km
Facteur d'emplacement de la structure adjacente		Aucun	C_{DJ}	–	Tableau A.1
Tension de tenue du réseau interne (kV)			U_{WP}	2,5	
Nombre de conducteurs		Conducteurs 3 phases + neutre	n_P	4	Tableau B.7
		Paramètre résultant	P_{LD}	1	Tableau B.11 et Tableau B.12
Distance latérale pour S2 (m)		U_{WP} est supérieur à U_{WT}	r_{MP}	-	Non utilisée, voir l'Équation (A.8) et le Tableau F.12
Distance latérale pour S4 (m)			r_{IP}	384	2 000/$U_{WP}^{1,8}$, voir l'Équation (A.12)

Tableau F.12 – Bâtiment de bureaux: ligne de communication

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Longueur (m)	Câble fibronique	L_L	0	Article A.4
Tension de tenue du réseau interne (kV) relié à la ligne de communication interne non blindée en cuivre.		U_{WT}	1,5	
Distance latérale pour S2 (m)	U_{WT} est inférieur à U_{WP}	r_{MT}	233	350/U_{WT}, voir l'Équation (A.8)

F.3.2 Calcul du nombre annuel prévisible d'événements dangereux

Les résultats des calculs sont donnés dans le Tableau F.13 pour les surfaces d'exposition et dans le Tableau F.14 pour le nombre prévisible d'événements dangereux.

Tableau F.13 – Bâtiment de bureaux: surfaces d'exposition de la structure et des lignes

	Symbole	Résultat m^2	Équation de référence
Structure	A_D	$2,75 \times 10^4$	Équation (A.3)
	A_M	$1,99 \times 10^5$	Équation (A.8)
Ligne de puissance	A_{LP1}	4×10^4	Équation (A.10)
	A_{IP1}	$7,69 \times 10^5$	Équation (A.12)
	A_{LP2}	4×10^3	Équation (A.10)
	A_{IP2}	$7,69 \times 10^4$	Équation (A.12)
Ligne de communication	A_{LT}	0	Équation (A.10)
	A_{IT}	0	Équation (A.12)

Tableau F.14 – Bâtiment de bureaux: nombre annuel prévisible d'événements dangereux

	Symbole	Résultat 1/an	Équation de référence
Structure	N_D	$1,1 \times 10^{-1}$	Équation (A.5)
	N_M	$3,98 \times 10^{-1}$	Équation (A.7)
Ligne de puissance	N_{LP1}	$4,8 \times 10^{-3}$	Équation (A.9)
	N_{IP1}	$4,61 \times 10^{-2}$	Équation (A.11)
	N_{LP2}	$2,4 \times 10^{-3}$	Équation (A.9)
	N_{IP2}	$2,31 \times 10^{-2}$	Équation (A.11)
Ligne de communication	N_{LT}	0	Équation (A.9)
	N_{IT}	0	Équation (A.11)

F.3.3 Évaluation des risques

Il convient, en premier lieu, d'identifier la façon dont la structure peut être découpée en zones. Pour chaque zone, le risque R de pertes d'importance publique et la fréquence F des dommages causés aux réseaux internes doivent être évalués.

Ceci entraîne:

a) la nécessité de déterminer le risque R et de le comparer au risque tolérable $R_T = 10^{-5}$ (7.3). Si nécessaire, des mesures de protection adaptées pour atténuer ce risque sont choisies. Les composantes de risque sont évaluées conformément au Tableau 3;

b) la nécessité de déterminer la fréquence de dommages F et de la comparer au risque tolérable exigé F_T (9.3). Dans ce cas, d'après les évaluations technico-économiques qui s'appliquent au service exploité dans le bâtiment, la fréquence de dommages tolérable a été fixée par le Directeur technique de la société à la valeur $F_T = 5 \times 10^{-2}$. Par conséquent, il convient de choisir des mesures de protection adaptées pour réduire cette fréquence des dommages, si nécessaire. Les composantes de la fréquence de dommages sont évaluées

F.3.4 Définition des zones dans le bâtiment de bureaux

Les zones suivantes sont définies:

Z_1 (zone d'entrée à l'extérieur);

Z_2 (toiture);

Z_3 (archives);

Z_4 (bureaux);

Z_5 (centre informatique);

en tenant compte des éléments suivants:

- des personnes peuvent avoir accès à la toiture;
- la structure est divisée en deux compartiments isolés à l'épreuve du feu: l'un pour les archives (Z_3) et l'autre pour les bureaux et le centre informatique (Z_4 et Z_5);
- toutes les zones intérieures Z_3, Z_4 et Z_5 comportent des réseaux internes connectés à des lignes de puissance et de communication;
- il n'y a pas de blindages spatiaux;
- les personnes qui se trouvent dans les zones extérieures Z_1 et Z_2 sont protégées contre un impact direct par la structure ou son SPF extérieur et il n'est donc pas nécessaire de calculer R_B pour ces zones dans cet exemple;
- les personnes qui se trouvent dans les zones extérieures Z_1 et Z_2 ne sont pas protégées contre des tensions de contact dues à un impact direct sur la structure et il est donc nécessaire de calculer R_{AT} pour ces zones.

L'utilisation de valeurs inférieures à 1 pour r_p a été choisie en accord avec le propriétaire du bâtiment (voir l'Article B.4).

Les valeurs de durée de présence annuelle des personnes dans chacune des zones et les composantes de risque à prendre en compte sont indiquées dans le Tableau F.15.

Tableau F.15 – Bâtiment de bureaux: durée de présence des personnes et composantes de risque dans les zones

Zone	Durée de présence heures/année	Composantes de risque								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_1 (entrée à l'extérieur)	175	X								
Z_2 (toiture)	18	X	X							
Z_3 (archive)	440	X		X			X	X		
Z_4 (bureaux)	2 630	X		X			X	X		
Z_5 (centre informatique)	2 200	X		X			X	X		

Les paramètres pertinents pour les zones Z_1 à Z_5 sont donnés dans les Tableaux F.16 à F.20.

Tableau F.16 – Bâtiment de bureaux: facteurs valables pour la zone Z_1 (zone d'entrée à l'extérieur)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Surface de sol	Marbre	r_t	10^{-3}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Aucun	r_f	0	Tableau B.6
Protection contre l'incendie	Aucun	r_p	1	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 175/8 760	P_P	0,02	Équation (B.14)
Facteur relatif aux matériels dans la zone	Non applicable	P_e	-	Équation (B.15)
Système de parafoudres (ligne de puissance)	Pas de réseaux internes	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Pas de réseaux internes	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Pas de réseaux internes	K_{S3}	0	Tableau B.10
Câblage interne (ligne de communication)	Pas de réseaux internes		0	
Type de zone en fonction des pertes	Zone à faibles pertes	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	
	Personnes blessées par incendie	L_{F1}	-	
	Dommages physiques causés par un incendie	L_{F2}	-	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	-	

Tableau F.17 – Bâtiment de bureaux: facteurs valables pour la zone Z_2 (toiture)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Surface de sol	Asphalte	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Équipe de maintenance présente dans la zone exposée	P_o	1	Article B.3
Risque d'incendie	Aucun	r_f	0	Tableau B.6
Protection contre l'incendie	Aucun	r_p	1	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 18/8 760	P_P	0,002	Équation (B.14)
Facteur relatif aux matériels dans la zone	Non applicable	P_e	-	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	-	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	-	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Pas de réseaux internes	K_{S3}	-	Tableau B.10
Câblage interne (ligne de communication)				
Type de zone en fonction des pertes	Zone à faibles pertes	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	10^{-1}	
	Personnes blessées par incendie	L_{F1}	-	
	Dommages physiques causés par un incendie	L_{F2}	-	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	-	

Tableau F.18 – Bâtiment de bureaux: facteurs valables pour la zone Z_3 (archives)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Élevé	r_f	10^{-1}	Tableau B.6
Protection contre l'incendie	Alarme automatique	r_p	0,2	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 440/8 760	P_P	0,05	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même conduit)	K_{S3}	0,2	Tableau B.10
Câblage interne (ligne de communication)	Non blindé (conducteurs de boucle avec différents acheminements)		1	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	U_W = 1,5 kV			
Type de zone en fonction des pertes	Zone à perte normale	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	
	Personnes blessées par incendie	L_{F1}	5×10^{-2}	
	Dommages physiques causés par un incendie	L_{F2}	5×10^{-2}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	5×10^{-2}	

Tableau F.19 – Bâtiment de bureaux: facteurs valables pour la zone Z_4 (bureaux)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Faible	r_f	10^{-3}	Tableau B.6
Protection contre l'incendie	Extincteurs	r_p	0,5	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 2 630/8 760	P_P	0,3	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même conduit)	K_{S3}	0,2	Tableau B.10
Câblage interne (ligne de communication)	Non blindé (conducteurs de boucle avec différents acheminements)		1	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	U_W = 1,5 kV			
Type de zone en fonction des pertes	Zone à perte normale	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	
	Personnes blessées par incendie	L_{F1}	5×10^{-2}	
	Dommages physiques causés par un incendie	L_{F2}	5×10^{-2}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	5×10^{-2}	

Tableau F.20 – Bâtiment de bureaux: facteurs valables pour la zone Z_5 (centre informatique)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Faible	r_f	10^{-3}	Tableau B.6
Protection contre l'incendie	Installation d'alarme automatique	r_p	0,2	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 2 200/8 760	P_P	0,25	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même conduit)	K_{S3}	0,2	Tableau B.10
Câblage interne (ligne de communication)	Non blindé (conducteurs de boucle avec différents acheminements)		1	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	U_W = 1,5 kV			
Type de zone en fonction des pertes	Zone à pertes élevées	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	
	Personnes blessées par incendie	L_{F1}	10^{-1}	
	Dommages physiques causés par un incendie	L_{F2}	10^{-1}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	5×10^{-2}	

F.3.5 Appréciation du risque

Le risque R peut être exprimé selon l'Équation (1). Les composantes impliquées sont indiquées dans le Tableau F.15 et les valeurs de risque dans le Tableau F.21.

Tableau F.21 – Bâtiment de bureaux: risque pour la structure non protégée (valeurs × 10^{-5})

Symbole	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,002	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	2,259	-	-	-
R_B	-	-	5,770	0,179	0,137
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,756	0,023	0,018
R	0,002	2,259	6,526	0,202	0,156
R_T	1				

Comme, dans les zones Z_2 et Z_3, le risque est supérieur à la valeur tolérable $R_T = 10^{-5}$, une protection contre la foudre de la structure est exigée pour atténuer le risque dans ces zones.

F.3.6 Évaluation de la fréquence des dommages

La fréquence des dommages F peut être exprimée selon l'Équation (12). Les composantes de fréquence doivent être évaluées conformément au 9.2. Les composantes impliquées et l'évaluation de la fréquence des dommages sont données dans le Tableau F.22.

Tableau F.22 – Bâtiment de bureaux: fréquence des dommages pour la structure non protégée

Symbole	Z_1	Z_2	Z_3	Z_4	Z_5
F_C	-	-	0,11	0,11	0,11
F_M	-	-	0,398	0,398	0,398
F_{WP}	-	-	0,007	0,007	0,007
F_{WT}	-	-	-	-	-
F_{ZP}	-	-	0,0692	0,0692	0,0692
F_{ZT}	-	-	-	-	-
F	-	-	0,584	0,584	0,584
F_T	-	-	0,05	0,05	0,05

Comme la fréquence des dommages F est supérieure à la valeur tolérable $F_T = 5 \times 10^{-2}$, une protection contre la foudre est exigée pour la structure afin de réduire la fréquence des dommages.

F.3.7 Risque – Choix de mesures de protection

D'après le Tableau F.21, la zone exposée au risque le plus élevé est la zone Z_3 (archives) en raison de la valeur élevée du risque d'incendie (composantes de risque R_B et R_V).

Des mesures de protection appropriées pour réduire le risque R dans la zone Z_3 consistent à installer un SPF de NPF II afin de protéger le bâtiment, ce qui réduit la composante de risque R_B dans les zones Z_2, Z_3, Z_4 et Z_5. D'après le Tableau B.3, cela permet de réduire la valeur de P_{LPS} de 1 à 0,05, la valeur de P_{EB} de 1 à 0,02 (en raison des parafoudres sur les lignes connectées) et, enfin, les valeurs de P_U et de P_V par le même facteur.

Pour la liaison équipotentielle, le SPF est équipé de parafoudres installés sur la ligne de puissance, à l'entrée de la ligne dans la structure.

L'application de ces mesures de protection permet d'obtenir de nouvelles valeurs de composantes de risque, comme cela est indiqué dans le Tableau F.23.

Tableau F.23 – Composantes de risque pour la structure protégée (valeurs × 10^{-5})

Symbole	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	0,113	-	-	-
R_B	-	-	0,577	0,018	0,014
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,015	≈ 0	≈ 0
R	≈ 0	0,113	0,592	0,018	0,014
R_T	1				

F.3.8 Fréquence des dommages – Choix de mesures de protection

Pour réduire la fréquence des dommages F à la valeur exigée (F_T = 5 × 10^{-2}), la mesure appropriée consiste à installer un système de protection par parafoudres coordonnés afin de protéger les réseaux internes connectés à la ligne de puissance.

La ligne de communication à l'intérieur du bâtiment est une ligne non blindée en cuivre et la protection du matériel de communication est donc également nécessaire, puisque cela a une incidence sur les composantes F_C et F_M.

D'après le Tableau F.22, un NPF II destiné à protéger les réseaux internes connectés à la ligne de puissance est approprié pour les systèmes de protection par parafoudres coordonnés. Le même NPF II est utilisé pour le parafoudre qui protège le matériel de communication interne.

Ce parafoudre réduit la valeur de P_{SPD} qui s'applique à la fréquence des dommages F_1 dans les zones Z_3, Z_4 et Z_5 de 1 à 0,02 et réduit également la valeur de P_{SPD} qui s'applique aux fréquences des dommages F_2, F_3 et F_4. Les nouvelles valeurs des composantes de la fréquence des dommages sont indiquées dans le Tableau F.24.

Tableau F.24 – Bâtiment de bureaux: fréquence des dommages pour la structure protégée

Symbole	Z_3	Z_4	Z_5
F_C	0,004	0,004	0,004
F_M	0,008	0,008	0,008
F_{WP}	≈ 0	≈ 0	≈ 0
F_{WT}	-	-	-
F_{ZP}	0,001	0,001	0,001
F_{ZT}	-	-	-
F	0,014	0,014	0,014
F_T	0,05	0,05	0,05

F.3.9 Conclusions

Le risque R et la fréquence des dommages F peuvent être réduits tous les deux au-dessous du niveau tolérable en installant:

– un SPF de NPF II pour protéger le bâtiment;
– un système de protection par parafoudres coordonnés de NPF II pour les réseaux de puissance et un parafoudre de NPF II pour le matériel de communication.

NOTE L'alarme incendie a été prise en compte dans le calcul des risques, car elle était protégée contre les surtensions et d'autres dommages et que les pompiers peuvent intervenir en moins de 10 min, comme cela est indiqué à l'Article B.4.

F.4 Hôpital

F.4.1 Données et caractéristiques pertinentes

Une étude de cas plus complexe concerne un établissement hospitalier classique qui comprend un bloc chambres, un bloc opératoire et une unité de soins intensifs.

L'hôpital est situé dans une région plate sans structures environnantes. La densité de points d'impact au sol de la foudre est N_{SG} = 8 (nombre d'impacts par km^2 et par an).

L'hôpital est desservi par une ligne de puissance et une ligne de communication. Deux parties conductrices externes sont reliées à la structure (canalisation d'eau et canalisation de gaz).

La ligne de communication est constituée de fibronique sans métal, à l'instar des réseaux internes auxquels elle est raccordée. Comme il est impossible de transmettre ou d'induire des chocs sur des lignes ou des circuits fibroniques, ces lignes et réseaux internes peuvent être négligés dans l'appréciation du risque et dans l'évaluation de la fréquence des dommages.

Les données relatives au bâtiment et à son environnement sont indiquées dans le Tableau F.25.

Les données relatives à la ligne de puissance entrante et aux réseaux internes connectés à cette ligne sont indiquées dans le Tableau F.26.

Tableau F.25 – Hôpital: caractéristiques de l'environnement et de la structure

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Densité de points d'impact au sol de la foudre (nombre de points d'impact par km^2 et par an)		N_{SG}	8,0	
Facteur qui lie N_G à N_{SG}		k	2	Article A.1
Dimensions de la structure (m)		L, W, H	50, 150, 10	
Facteur d'emplacement de la structure	Structure isolée	C_D	1	A.2.3, Tableau A.1
Matériau de construction	Béton armé	P_S	0,5	Article B.4, Tableau B.4
Blindage de la structure	Aucun	K_{S1}	1	Article B.6, Équation (B.8)
Facteur d'environnement	Suburbain	C_E	0,5	Article A.4, Tableau A.4
SPF	Aucun	P_{LPS}	1	Article B.3, Tableau B.3
TWS	Aucun	P_{TWS}	1	Article B.1

Tableau F.26 – Hôpital: ligne de puissance

Paramètre d'entrée		Commentaire	Symbole	Valeur	Référence
Section HT	Longueur (m)		L_L	1 000	Article A.4
	Facteur d'installation	Enterrée	C_I	0,3	Tableau A.2
	Facteur de type de ligne	Ligne HT	C_T	0,2	Tableau A.3
	Facteur d'environnement	Suburbain	C_E	0,5	Tableau A.4
	Blindage de ligne (Ω/km)	Non blindée	R_S	–	
Section BT	Longueur (m)		L_L	50	
	Facteur d'installation	Enterrée	C_I	0,3	Tableau A.2
	Facteur de type de ligne	Ligne BT	C_T	1	Tableau A.3
	Facteur d'environnement	Suburbain	C_E	0,5	Tableau A.4
	Blindage de ligne (Ω/km)	Non blindée	R_S	–	
Blindage, mise à la terre, isolation		Aucun	C_{LD}	1	Tableau B.9
			C_{LI}	1	
Liaison équipotentielle		Aucun	P_{EB}	1	Tableau B.13
Structure adjacente		Aucun	L_J, W_J, H_J	–	La longueur de la ligne HT est de 1 km
Facteur d'emplacement de la structure adjacente		Aucun	C_{DJ}	–	Tableau A.1
Tension de tenue du réseau interne (kV)			U_W	2,5	
Nombre de conducteurs		Conducteurs 3 phases + neutre	n_P	4	Tableau B.7
		Paramètre			

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Distance latérale pour S2 (m)		r_{MP}	140	$350/U_{WP}$, voir l'Équation (A.8)
Distance latérale pour S4 (m)		r_{IP}	384	$2\,000/U_{WP}^{1,8}$, voir l'Équation (A.12)

F.4.2 Calcul du nombre annuel prévisible d'événements dangereux

Les résultats des calculs sont donnés dans le Tableau F.27 pour les surfaces d'exposition et dans le Tableau F.28 pour le nombre prévisible d'événements dangereux.

Tableau F.27 – Hôpital: surfaces d'exposition de la structure et de la ligne de puissance

	Symbole	Résultat m²	Équation de référence
Structure	A_D	$2,23 \times 10^4$	Équation (A.3)
	A_M	$1,18 \times 10^5$	Équation (A.8)
Ligne de puissance	A_{LP1}	$4,00 \times 10^4$	Équation (A.10)
	A_{IP1}	$7,69 \times 10^5$	Équation (A.12)
	A_{LP2}	$2,00 \times 10^3$	Équation (A.10)
	A_{IP2}	$3,84 \times 10^4$	Équation (A.12)

Tableau F.28 – Hôpital: nombre annuel prévisible d'événements dangereux

	Symbole	Résultat 1/an	Équation de référence
Structure	N_D	$1,79 \times 10^{-1}$	Équation (A.5)
	N_M	$4,70 \times 10^{-1}$	Équation (A.7)
Ligne de puissance	N_{LP1}	$9,6 \times 10^{-3}$	Équation (A.9)
	N_{IP1}	$9,23 \times 10^{-2}$	Équation (A.11)
	N_{LP2}	$2,4 \times 10^{-3}$	Équation (A.9)
	N_{IP2}	$2,31 \times 10^{-2}$	Équation (A.11)
	N_{LP}	$1,2 \times 10^{-2}$	
	N_{IP}	$1,15 \times 10^{-1}$	

F.4.3 Évaluation des risques

Il convient, en premier lieu, d'identifier la façon dont la structure peut être découpée en zones. Pour chaque zone, le risque R et la fréquence des dommages F causés aux réseaux internes sont évalués.

Ceci entraîne:

a) la nécessité de déterminer le risque R et de le comparer au risque tolérable $R_T = 10^{-5}$ (7.3). Si nécessaire, des mesures de protection adaptées pour atténuer ce risque sont choisies. Les composantes de risque sont évaluées conformément au Tableau 3;

b) la nécessité de déterminer la fréquence de dommages F et de la comparer au risque tolérable exigé F_T (9.3). Dans ce cas, d'après les évaluations relatives à la qualité du service fourni par l'hôpital, la fréquence tolérable des dommages a été fixée par le Directeur général de l'hôpital à la valeur $F_T = 10^{-2}$ pour le bloc opératoire et l'unité de soins intensifs, et à la valeur $F_T = 5 \times 10^{-2}$ pour le bloc chambres. Si nécessaire, des mesures de protection adaptées sont choisies pour réduire cette fréquence des dommages. Les composantes de la fréquence de dommages sont évaluées conformément au 9.2.

F.4.4 Définition des zones de l'hôpital

Les zones suivantes sont définies comme suit:

Z_1 (zone d'entrée à l'extérieur);

Z_2 (toiture);

Z_3 (bloc chambres);

Z_4 (bloc opératoire);

Z_5 (unité de soins intensifs);

en tenant compte des éléments suivants:

– le type de surface est différent à l'intérieur et à l'extérieur;
– deux compartiments isolés à l'épreuve du feu existent: un pour le bloc chambres (Z_3) et l'autre pour le bloc opératoire et l'unité de soins intensifs (Z_4 et Z_5);
– dans toutes les zones intérieures Z_3, Z_4 et Z_5, des réseaux internes sont connectés à la ligne de puissance;
– il n'y a pas de blindages spatiaux;
– l'unité de soins intensifs contient de nombreux réseaux de communication sensibles et un blindage spatial peut être adopté comme mesure de protection;
– les personnes qui se trouvent dans les zones extérieures Z_1 et Z_2 sont protégées contre un impact direct par la structure ou son SPF extérieur et il n'est donc pas nécessaire de calculer R_B pour ces zones dans cet exemple;
– les personnes qui se trouvent dans les zones extérieures Z_1 et Z_2 ne sont pas protégées contre des tensions de contact dues à un impact direct sur la structure et il est donc nécessaire de calculer R_{AT} pour ces zones.

L'utilisation de valeurs inférieures à 1 pour r_p a été choisie en accord avec le propriétaire du bâtiment (voir l'Article B.4).

Les valeurs de durée de présence annuelle des personnes dans chacune des zones et les composantes de risque à prendre en compte sont indiquées dans le Tableau F.29.

Tableau F.29 – Hôpital: durée de présence des personnes et composantes de risque dans les zones

Zone	Durée de présence heures/année	Composantes de risque								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_1 (entrée à l'extérieur)	175	X								
Z_2 (toiture)	90	X	X				X			
Z_3 (bloc chambres)	8 760	X		X	X	X	X	X	X	X
Z_4 (bloc opératoire)	3 100	X		X	X	X	X	X	X	X
Z_5 (unité de soins intensifs)	8 760	X		X	X	X	X	X	X	X

Les paramètres définis pour les zones Z_1 à Z_5 sont donnés dans les Tableaux F.30 à F.34.

Tableau F.30 – Hôpital: facteurs valables pour la zone Z_1 (à l'extérieur du bâtiment)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Surface de sol	Béton	r_t	10^{-2}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Aucun	r_f	-	Tableau B.6
Protection contre l'incendie	Aucun	r_p	-	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 175/8 760	P_P	0,02	Équation (B.14)
Facteur relatif aux matériels dans la zone	Non applicable	P_e	-	Équation (B.15)
Blindage de la zone	Aucun	K_{S2}	-	Équation (B.9)
Câblage interne (ligne de puissance)	Pas de réseaux internes	K_{S3P}	-	Tableau B.10
Câblage interne (ligne de communication)	Pas de réseaux internes	K_{S3T}	-	
Type de zone en fonction des pertes	Zone à faibles pertes	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	Tableau C.2
	Personnes blessées par incendie	L_{F1}	-	
	Dommages physiques causés par un incendie	L_{F2}	-	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	-	

Tableau F.31 – Hôpital: facteurs valables pour la zone Z_2 (toiture)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Surface de sol	Asphalte	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Équipe de maintenance présente dans la zone exposée	P_o	1	Article B.3
Risque d'incendie	Aucun	r_f	0	Tableau B.6
Protection contre l'incendie	Aucun	r_p	-	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 90/8 760	P_P	0,01	Équation (B.14)
Facteur relatif aux matériels dans la zone	Non applicable	P_e	-	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	-	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	-	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	-	Équation (B.9)
Câblage interne (ligne de puissance)	Non applicable	K_{S3P}	-	Tableau B.10
Câblage interne (ligne de communication)	Pas de réseaux internes	K_{S3T}	-	
Type de zone en fonction des pertes	Zone à faibles pertes	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	10^{-1}	Tableau C.2
	Personnes blessées par incendie	L_{F1}	-	
	Dommages physiques causés par un incendie	L_{F2}	-	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	Tableau B.2
	Fréquence des dommages	F_T	-	Tableau B.1

Tableau F.32 – Hôpital: facteurs valables pour la zone Z_3 (chambres)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Ordinaire	r_f	10^{-2}	Tableau B.6
Protection contre l'incendie	Alarme automatique	r_p	0,2	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 8 760/8 760	P_P	1	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même conduit)	K_{S3P}	0,2	Tableau B.10
Câblage interne (ligne de communication)	Câbles fibroniques non métalliques	K_{S3T}	-	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	Non applicable			
Type de zone en fonction des pertes	Zone à pertes élevées	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	Tableau C.2
	Personnes blessées par incendie	L_{F1}	10^{-1}	
	Dommages physiques causés par un incendie	L_{F2}	10^{-1}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	10^{-3}	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	5×10^{-2}	

Tableau F.33 – Hôpital: facteurs valables pour la zone Z_4 (bloc opératoire)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Faible	r_f	10^{-3}	Tableau B.6
Protection contre l'incendie	Installations d'alarmes automatiques	r_p	0,2	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 3 100/8 760	P_P	0,35	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	-	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même câble)	K_{S3P}	0,01	Tableau B.10
Câblage interne (ligne de communication)	Câbles fibroniques non métalliques	K_{S3T}	-	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	Non applicable			
Type de zone en fonction des pertes	Zone à pertes très élevées	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	Tableau C.2
	Personnes blessées par incendie	L_{F1}	2×10^{-1}	
	Dommages physiques causés par un incendie	L_{F2}	2×10^{-1}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	10^{-2}	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	10^{-2}	

Tableau F.34 – Hôpital: facteurs valables pour la zone Z_5 (unité de soins intensifs)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Faible	r_f	10^{-3}	Tableau B.6
Protection contre l'incendie	Installations d'alarmes automatiques	r_p	0,2	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 8 760/8 760	P_P	1	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même câble)	K_{S3P}	0,01	Tableau B.10
Câblage interne (ligne de communication)	Câbles fibroniques non métalliques	K_{S3T}	-	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	Non applicable			
Type de zone en fonction des pertes	Zone à pertes très élevées	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	Tableau C.2
	Personnes blessées par incendie	L_{F1}	2×10^{-1}	
	Dommages physiques causés par un incendie	L_{F2}	2×10^{-1}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	10^{-2}	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	10^{-2}	

F.4.5 Appréciation du risque

Le risque R peut être exprimé selon l'Équation (1). Les composantes impliquées sont indiquées dans le Tableau F.29 et les valeurs de risque dans le Tableau F.35.

Tableau F.35 – Hôpital: risque pour la structure non protégée (valeurs × 10^{-5})

Symbole	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,036	≈ 0	0,002	0,001	0,002
R_{AD}	-	18 357	-	-	-
R_B	-	-	3,572	0,484	0,714
R_C	-	-	17,862	63,213	178,619
R_M	-	-	1,881	0,017	0,047
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,480	0,065	0,096
R_W	-	-	1,200	4,247	12,000
R_Z	-	-	11,531	40,807	115,308
R	0,036	18 357	36,528	108,834	306,787
R_T	1				

Comme, dans les zones Z_2, Z_3, Z_4 et Z_5, le risque R est supérieur à la valeur tolérable $R_T = 10^{-5}$, une protection contre la foudre de la structure est exigée pour atténuer le risque dans ces zones.

F.4.6 Évaluation de la fréquence des dommages

La fréquence des dommages F peut être exprimée selon l'Équation (12). Les composantes de fréquence doivent être évaluées conformément au 9.2. Les composantes impliquées et l'évaluation de la fréquence totale sont données dans le Tableau F.36.

Tableau F.36 – Hôpital: fréquence des dommages pour la structure non protégée

Symbole	Z_3	Z_4	Z_5
F_C	0,179	0,179	0,179
F_M	0,019	≈ 0	≈ 0
F_W	0,012	0,012	0,012
F_Z	0,115	0,115	0,115
F	0,325	0,306	0,306
F_T	0,05	0,01	0,01

NOTE Aucune valeur n'est spécifiée pour la zone Z_2, puisque le Tableau F.31 indique que la zone Z_2 ne contient aucun matériel.

La considération suivante peut être faite en s'appuyant sur le Tableau F.36: comme la fréquence des dommages F est supérieure aux valeurs tolérables F_T dans toutes les zones où des réseaux internes sont installés, une protection du matériel contre les chocs est exigée dans la structure afin de réduire la fréquence des dommages.

F.4.7 Risque – Choix de mesures de protection

D'après le Tableau F.35, les zones exposées au risque le plus élevé sont en général les suivantes:

- Z_5 (unité de soins intensifs);
- Z_4 (bloc opératoire); en raison de la valeur élevée des défaillances des réseaux internes R_C (composante de risque $R_C \approx 70$ % du risque total dans la zone correspondante), il est nécessaire de réduire P_C.

Des valeurs de risque élevées sont également constatées dans les zones suivantes:

- Z_3 (bloc chambres), en raison de la valeur élevée de présence de personnes dans la zone (composantes de risque R_B, R_C et R_Z);
- Z_2 (toiture), en raison de la forte probabilité d'un impact de foudre direct sur des personnes qui se tiennent debout dans la zone exposée (composante de risque R_{AD}).

Ces composantes de risque prédominantes peuvent être réduites par les mesures suivantes:

a) placer dans le bâtiment un panneau d'avertissement qui interdit au personnel de maintenance d'aller sur la toiture pendant un orage, ce qui réduit la composante de risque R_{AD} (P_{am} = 0,1 pour la zone Z_2);

b) équiper l'ensemble du bâtiment (y compris les zones exposées sur la toiture) d'un SPF de classe II conforme à l'IEC 62305-3, ce qui réduit les composantes R_{AD} et R_B par la probabilité P_{LPS} = 0,05. Pour la liaison équipotentielle, le SPF est équipé de parafoudres installés sur la ligne de puissance, à l'entrée de la ligne dans la structure (NPF II). L'établissement obligatoire de la liaison équipotentielle de foudre réduit également les composantes R_U et R_V par l'intermédiaire de la probabilité P_{EB} = 0,02;

c) équiper les zones Z_3, Z_4 et Z_5 d'un système de protection par parafoudres coordonnés conforme à l'IEC 62305-4 pour les réseaux internes de puissance. Ceci permet de réduire les composantes R_C, R_M et R_W et R_Z par l'intermédiaire de la probabilité P_{SPD}.

   - Zone Z_3: NPF I, P_{SPD} = 0,01;
   - Zone Z_4: meilleur que le NPF I, P_{SPD} = 0,002;
   - Zone Z_5: meilleur que le NPF I, P_{SPD} = 0,002.

Avec cette solution, les valeurs de risque du Tableau F.35 varient pour conduire aux valeurs réduites indiquées dans le Tableau F.37.

Tableau F.37 – Hôpital: risque pour la structure protégée (valeurs × 10^{-5})

Symbole	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,002	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	0,092	-	-	-
R_B	-	-	0,357	0,048	0,071
R_C	-	-	0,179	0,126	0,357
R_M	-	-	0,019	≈ 0	≈ 0
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,010	0,001	0,002
R_W	-	-	0,012	0,008	0,024
R_Z	-	-	0,115	0,082	0,231
R	0,002	0,092	0,692	0,266	0,685
R_T	1				

F.4.8 Fréquence des dommages – Choix de mesures de protection

Pour réduire la fréquence des dommages F à la valeur exigée F_T, la mesure appropriée consiste à installer un système de protection par parafoudres coordonnés afin de protéger les réseaux internes connectés à une ligne de puissance.

D'après le Tableau F.38, la solution à utiliser pour réduire le risque R s'applique également pour réduire la fréquence des dommages. Un système de protection par parafoudres coordonnés convient pour protéger les réseaux internes connectés à une ligne de puissance.

Un tel système SPD réduit la valeur de P_{SPD} dans la zone Z_3 de 1 à 0,01, et dans les zones Z_4 et Z_5 de 1 à 0,002. Les nouvelles valeurs des composantes de la fréquence des dommages sont indiquées dans le Tableau F.38.

Tableau F.38 – Hôpital: fréquence des dommages pour la structure protégée

Symbole	Z_3	Z_4	Z_5
F_C	0,001 8	0,000 4	0,000 4
F_M	0,000 2	≈ 0	≈ 0
F_W	0,000 1	≈ 0	≈ 0
F_Z	0,001 1	0,000 2	0,000 2
F	0,003 2	0,000 6	0,000 6
F_T	0,05	0,01	0,01
NOTE Dans ce tableau, des nombres à 4 décimales sont utilisés en raison des valeurs très faibles.			

F.4.9 Conclusions

Le risque R et la fréquence des dommages F peuvent être réduits tous les deux au-dessous du niveau tolérable en installant:

– un panneau d'avertissement qui interdit au personnel de maintenance d'aller sur la toiture lors d'orages;

– un SPF de classe II pour protéger le bâtiment et les zones exposées sur la toiture, ce qui comprend l'établissement d'une liaison équipotentielle pour la ligne de puissance entrante pour un NPF II;

– un système de protection par parafoudres coordonnés pour les réseaux de puissance dans toutes les zones.

NOTE L'alarme incendie a été prise en compte dans le calcul des risques, car elle était protégée contre les surtensions et d'autres dommages et que les pompiers ont pu intervenir en moins de 10 min, comme cela est indiqué à l'Article B.4.

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S12298-G5General Comment

I am George Portfleet a member of the United Lightning Protection Association. I am writing to voice my support for S12298, a proposal that promotes safer, more resilient Risk Category IV buildings, facilities critical to public safety during emergencies. Requiring a lightning risk assessment based on recognized national and international standards, this proposal will provide informed, objective decisions without mandating unnecessary systems. It enhances life safety, supports business continuity, and strengthens community resilience during Florida’s frequent storm events.

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S12298-G4General Comment

I am George Portfleet a member of the United Lightning Protection Association. I am writing to voice my support for S12298, a proposal that promotes safer, more resilient Risk Category IV buildings, facilities critical to public safety during emergencies. Requiring a lightning risk assessment based on recognized national and international standards, this proposal will provide informed, objective decisions without mandating unnecessary systems. It enhances life safety, supports business continuity, and strengthens community resilience during Florida's frequent storm events.

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The problem:

There is a lack of a standardized, detailed methodology within the IBC to assess and mitigate lightning risks specifically for Risk Category IV buildings and other structures. These buildings contain essential facilities (e.g., hospitals, emergency shelters) and also those buildings where the loss of function is a real hazard to the occupants/users. The assignment in Risk Category IV is to help ensure these buildings maintain functionality and safety during natural hazards; in this case severe weather events. This specialized code language will provide a systematic, accurate, and consistent approach to evaluating lightning risk for these essential uses and recommend protective measures.

Specific examples:

Lightning strikes can significantly disrupt hospital operations, affecting both infrastructure and patient care. Key impacts include:

Electrical and Electronic System Failures:

a. Power Supply Disruptions: Lightning can cause power outages, compromising critical systems. For instance, a 2017 lightning strike at a Florida hospital led to a fire and subsequent failure of backup power systems, necessitating the evacuation of 225 patients.
b. Equipment Damage: Sensitive medical devices are vulnerable to voltage spikes from lightning, potentially leading to malfunctions or complete failure. This can impede patient monitoring and treatment.

Communication System Interruptions:

a. Lightning-induced surges can disrupt hospital communication networks, including telephones, intercoms, and internet services, hindering coordination among medical staff and with external emergency services.

Structural Damage:

a. Direct lightning strikes can cause fires or physical damage to hospital buildings, posing safety risks to patients and staff and potentially leading to evacuations.

To safeguard against these risks, hospitals can implement comprehensive lightning protection systems. These mitigation measures include:

- External Protection: Installation of lightning rods and other systems to intercept strikes.
- Surge Protection Devices (SPDs): To shield electrical and electronic equipment from voltage spikes.
- Equipotential Bonding: Ensuring all conductive parts within the hospital are at the same electrical potential to prevent dangerous voltage differences during a lightning event.
- Regular Maintenance and Compliance: Adhering to standards such as NFPA 70, NFPA 780, and UL 96A to ensure the effectiveness of lightning protection systems.

Implementing these measures can enhance hospital resilience against lightning-related incidents, ensuring continuity of critical healthcare services.

Historical Losses:

Documented instances of lightning strikes have shown that they can cause fires in critical infrastructure, power outages disrupting emergency operations, and structural damage leading to costly repairs and operational downtime.

The quantification of Impact: The new language can incorporate data from past incidents to model the economic, structural, and human costs of lightning-related failures. This data-driven foundation helps stakeholders understand the necessity of robust lightning protection.

Over the past five years, lightning strikes have significantly impacted commercial properties in the United States, leading to substantial insurance claims and financial losses. Key statistics include:

- Percentage of Claims: Lightning-induced fires account for approximately 3% to 5% of all U.S. commercial property insurance claims annually. (Institute for Intergovernmental Research) https://www.iii.org/press-release/struck-by-lightning-how-businesses-canbecome-more-resilient-triple-i-and-lpi
- Annual Financial Impact: These incidents result in over $2 billion in insured losses each year for small and medium-sized businesses. (Institute for Intergovernmental Research) https://www.iii.org/press-release/when-lightning-strikes-how-business-canprotect-its-bottom-line
- Types of Damage: Lightning can cause fires, structural damage, and electrical system failures, leading to significant financial burdens for businesses. (Voss Law Firm) https://www.vosslawfirm.com/blog/a-guide-to-commercial-insurance-claims-for-lightningstrikes.
- While specific annual data for each of the past five years is limited, these figures highlight the consistent and substantial impact of lightning on commercial properties.

Implementing the analysis of the benefits of certified lightning protection systems and then securing appropriate insurance coverage are essential steps for businesses to mitigate these risks.

Lightning strikes have been responsible for several significant power outages. Notable instances include:

1. New York City Blackout (1977)

Date: July 13–14, 1977

Cause: A severe lightning storm led to a series of electrical failures, beginning with a lightning strike on a substation on the Hudson River. This initiated a cascading failure throughout the city's power grid.

Impact: Approximately 9 million people were affected by the power outage, which lasted around 25 hours. The blackout resulted in widespread looting, arson, and significant property damage.

2. Southern Brazil Blackout (1999)

Date: March 11, 1999

S12298Rationale

Cause: A lightning strike at an electricity substation in Bauru, São Paulo State, caused most of the 440kV circuits at the substation to trip. This led to a chain reaction resulting in a widespread power outage.

Impact: The blackout affected an estimated 75 to 97 million people across multiple states, including São Paulo, Rio de Janeiro, and Minas Gerais.

3. United Kingdom Power Outage (2019):

Date: August 9, 2019

Cause: A lightning strike on a transmission line led to the loss of 500 MW of embedded generation. Subsequently, two large generators, Little Barford Power Station and Hornsea Wind Farm, tripped, causing a significant drop in frequency.

Impact: Experienced power cuts for 15 to 20 minutes. The outage also caused substantial travel disruption, particularly on the railway network, and affected infrastructure such as Newcastle Airport and Ipswich Hospital.

These events highlight the vulnerability of power grids to lightning strikes and underscore the importance of robust infrastructure and responsive measures to mitigate such risks.

<u>How does this increase protection?</u>

This code change will provide the following safety enhancements:

- Reduce risk of structural fires and electrical surges caused by lightning.
- Protect occupants and critical assets within the buildings.
- Ensure that the functionality of the essential facilities continue.
- Failures in electrical systems can affect life-sustaining equipment, such as ventilators and infusion pumps, endangering patient health, especially in intensive care units.

This code change will also provide improvements to functionality that ensures continuity of operations for essential services during severe weather, such as healthcare and emergency response. It will also minimize downtime by integrating resilient design features and protective measures while also facilitating adherence to higher safety standards for critical infrastructure, ensuring alignment with federal or state mandates.

<u>Other Thoughts:</u>

The proposed language can also accommodate different geographic and environmental factors by including variables like regional lightning density, soil conductivity, and building materials to tailor recommendations.

The proposed language could include cost-benefit analyses of different protection systems, enabling informed decisions about resource allocation. The Cost per Square Foot for Low-Rise Buildings is approximately $2.10 to $2.70 per square foot of roof area and Five-Story Buildings is approximately $1.50 to $1.90 per square foot of roof area.

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Mod_12298_Rationale_Reason Statement.pdf

The new language should help streamline assessments to integrate seamlessly into design and approval phases, avoiding delays in the construction timeline.

Cost Impact: Increase

Estimated Immediate Cost Impact: The proposed language could include cost-benefit analyses of different protection systems, enabling informed decisions about resource allocation. The Cost per Square Foot of such systems for Low-Rise Buildings is approximately $2.10 to $2.70 per square foot of roof area and Five-Story Buildings is approximately $1.50 to $1.90 per square foot of roof area for the installation of such protective systems based on industry studies. It should be noted however that the code change only requires the hazard assessment for Risk Category IV buildings or structures and that is considerably less in cost. The decision to install such a protective system would be a factor in whether or not it was needed for the use.

Estimated Immediate Cost Impact Justification (methodology and variables): The cost impacts are based on industry studies. It is a simple cost of system over roof area provided. The new language should help streamline assessments to integrate seamlessly into design and approval phases, avoiding delays in the construction timeline.

Estimated Life Cycle Cost Impact: This proposal only requires an analysis of whether the use needs protection from lightning storms. Therefore it is only a slight increase.

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

E12031

10

Date Submitted	02/12/2025	**Section**	2703	**Proponent**	Bryan Holland
Chapter	27	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

N/A

Summary of Modification

This proposed modification would add mandatory lightning and surge protection requirements for risk category III or IV buildings and structures.

Rationale

This proposed modification would ensure that buildings or structures that "represent a substantial hazard to human life in the event of failure or have been designated as essential facilities and buildings where loss of function represents a substantial hazard to occupants or users" are protected against the hazard of lightning and transient power surges. Currently, the FBC-B only requires lightning and surge protection for hospitals, nursing homes, and state requirements for educational facilities. There are many other risk category III and IV buildings and structures that are highly vulnerable to the hazard of lightning that would be mitigated by this requirement. A Carnegie-Mellon study shows that 33% of businesses are affected by lightning and that more businesses are negatively impacted by lightning storms than by floods, fires, explosions, hurricanes, and earthquakes combined. Insured losses on property exceeds $5 billion dollars annually from lightning damage alone. According to the Insurance Information Institute, lightning fires in non-residential properties causes an average of $108 million in direct property damage each year. These stats only take into account the insured losses reported and do not include uninsured losses, lost productivity, lost sales, lost inventory, and other considerable factors.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

This proposed modification will require the local entity to require the permitting, plan review, and inspection of lightning and surge protection on qualified projects.

Impact to building and property owners relative to cost of compliance with code

This proposed modification will increase the cost of compliance with the code for risk category III and IV projects only. This cost is typically less than 1% of the total cost of construction: https://ecle.biz/coststudy/

Impact to industry relative to the cost of compliance with code

This proposed modification will increase the cost of compliance with the code for risk category III and IV projects only. This cost is typically less than 1% of the total cost of construction: https://ecle.biz/coststudy/

Impact to small business relative to the cost of compliance with code

This proposed modification will increase the cost of compliance with the code for risk category III and IV projects only. This cost is typically less than 1% of the total cost of construction: https://ecle.biz/coststudy/

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposed modification improves the health, safety, and welfare of the general public by risk category III and IV buildings and structures from the negative impacts of lightning and transient power surges.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification improves the code mitigating a significant environmental risk to highly vulnerable buildings and structures.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

This proposed modification improves the effectiveness of the code.

1st Comment Period History

E12031-G1

Proponent	Dillon Mike	Submitted	4/10/2025 11:44:49 AM	Attachments	No

Comment:

My name is Michael Dillon, and I am with Bonded Lightning Protection. I represent the Lightning Protection Industry, as an installer in Florida. I support this because it aligns the Florida Building Code with the national model code (IBC). It also, mandates LPS installations for the most vulnerable and essential building and structures, but it does not mandate LPS installation where the risk assessment indicates protection is unnecessary. This will likely increase hte number of LPS installation projects for risk category III & IV buildings and structures and will align surge protection requirements between NPA 70 & NFPA 780

1st Comment Period History

E12031-G2

Proponent	Tyler Baumert	Submitted	4/14/2025 2:53:19 PM	Attachments	No

Comment:

My name is Tyler Baumert, and I represent the Lightning Protection Coalition. I am writing to express strong support for Proposal E12031. Proposal E12031 mandates lightning and surge protection for Risk Category III and IV structures, including emergency response centers, hospitals, and critical infrastructure. These facilities are particularly vulnerable to lightning-related disruptions. By aligning Florida with national model codes and incorporating NFPA 70 and NFPA 780, this proposal provides code clarity, enforcement consistency, and enhanced protection—with predictable cost impacts and flexibility through risk assessments.

1st Comment Period History

E12031-G3

Proponent	Bret Peifer	Submitted	4/14/2025 3:42:41 PM	Attachments	No

Comment:
As a licensed lightning protection contractor, Bret Peifer of Mr. Lightning, I fully support the proposed modification to the Florida Building Code requiring mandatory lightning and surge protection for Risk Category III and IV buildings and structures. These facilities—including critical infrastructure such as hospitals, emergency response centers, and shelters—play a vital role in public safety and disaster response. Given Florida's status as one of the most lightning-prone states in the U.S., enhancing their resilience against lightning strikes and electrical surges is a necessary and prudent step. This change not only protects valuable infrastructure but also helps ensure continuity of essential services during severe weather events. It's a smart, forward-thinking measure that aligns with Florida's commitment to public safety and disaster preparedness.

1st Comment Period History

E12031-G4

Proponent	harger Tim	Submitted	4/15/2025 4:29:15 PM	Attachments	No

Comment:
I am Tim Harger with the Lightning Protection Institute, and I support Proposal E12031. This modification enhances protection for Florida's most essential buildings by mandating lightning and surge protection systems for Risk Category III and IV structures. These facilities—such as emergency response centers, healthcare facilities, and critical infrastructure—are particularly vulnerable to lightning-related disruptions. The proposal aligns Florida with the latest national model codes and integrates NFPA 70 and NFPA 780 for consistency

1st Comment Period History

E12031-G5

Proponent	George Po	Submitted	4/16/2025 4:03:08 PM	Attachments	Yes

Comment:

Support of E12031

Section 2703

Lightning Protection Systems

2703.1 General. Lightning protection systems shall comply with Sections 2703.2 and 2703.3.

2703.2 Where required. Lightning protection systems shall be installed on each building and structure assigned a risk category III or IV in accordance with Table 1604.5.

Exception: Lightning protection systems shall not be required for any building or structure where determined to be unnecessary by evaluation using the Lightning Risk Assessment in NFPA 780 or an alternative method approved by the building official.

2703.3 Surge Protection. Where lightning protection systems are installed, surge protection shall also be installed in accordance with NFPA 70.

My name is George Portfleet Master Electrician and member of the United Lightning Protection Association lending my support to Proposal E12031. This modification enhances protection for Florida's most essential buildings by mandating lightning and surge protection systems for Risk Category III and IV structures. These facilities, including emergency response centers, healthcare facilities, and critical infrastructure are particularly vulnerable to lightning-related disruptions.

Proposal E12031 aligns Florida with the latest national model codes and integrates NFPA 70 and NFPA 780 for consistency and clarity allowing predictable cost impact and flexibility through risk assessments. This change will help protect lives, support resilient infrastructure, and streamline enforcement across jurisdictions.

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

E12324

11

Date Submitted	02/18/2025	**Section**	2701	**Proponent**	Joseph Belcher
Chapter	27	**Affects HVHZ**	Yes	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments Yes

Alternate Language No

Related Modifications

Summary of Modification

Eliminate ACFI in kitchens

Rationale

Arc Fault interrupters installed in kitchens are too sensitive and are the source of numerous service calls. It is reported that when attempting to use numerous small appliances such as mixers, blenders, or microwave ovens. The interrupters activate. The constant tripping of the interrupters results in service calls. Often the sole fix is for the electrician to replace the interrupter with a standard circuit breaker.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None.

Impact to building and property owners relative to cost of compliance with code

A reduction of $50-$350 per breaker, including materials and labor. In addition, there will be a reduction in the cost of service calls to replace the arc fault interrupters

Impact to industry relative to the cost of compliance with code

A reduction of $50-$350 per breaker, including materials and labor. In addition, there will be a reduction in the cost of service calls to replace the arc fault interrupters.

Impact to small business relative to the cost of compliance with code

A reduction of $50-$350 per breaker, including materials and labor. In addition, there will be a reduction in the cost of service calls to replace the arc fault interrupters.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The change will improve public welfare by eliminating a recurring nuisance, making the use of small appliances in the kitchen impossible.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The change will improve the code by eliminating a recurring nuisance, making the use of small appliances in the kitchen impossible.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The change does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

The proposed change does not degrade the code's effectiveness and improves the code's effectiveness.

1st Comment Period History

E12324-G1

Proponent	Bryan Holland	Submitted	3/27/2025 10:38:38 AM	Attachments	Yes

Comment:

NEMA urges the Electrical TAC and Commission to reject this proposed modification that reduces electrical fire safety in dwelling units. The reports of unwanted tripping of AFCI protection devices supplying kitchen branch circuits are anecdotal at best. There are currently no known compatibility issues between AFCI protection and cord-and-plug-connected appliances frequently used in kitchens. (See the attached document titled: NEMA BS 31026-2023) Kitchen fires in dwellings tend to be the most common location of fire and the deadliest fires for dwelling occupants. Removing a fire-prevention device for electrical circuits supplying a residential kitchen is dangerous and can only lead to more loss of life and property. AFCI protection predates the 1st edition of the Florida Building Code and has been an effective means of reducing residential fires since 1999. (See the attached document titled: AFCI INFORGRAHIC – NEMA 2024) It should also be noted that there have been no reported electrical fires in a residential kitchen in Florida that is protected by AFCI protection. The reduction of fire attributed to AFCI protection has reduced insurance premiums and the number of insurance claims. The benefits to the homeowner go beyond just safety and include financial incentives. (See the attached document titled: ECM-Lowering Home Costs Should Not Abandon National Electrical Safety Requirements)

1st Comment Period History

E12324-G2

Proponent	Amber Wilcox	Submitted	4/16/2025 1:26:51 PM	Attachments	Yes

Comment:

Dear Florida Electrical Technical Advisory Committee Members, My name is Amber Wilcox, and I reside at 27 Blockhouse Ct, Ormond Beach, FL 32174. I'm writing to respectfully urge you to vote against the proposal to delete "kitchens" from section 210.12 of the Florida Building Code, which would eliminate the requirement for arc fault circuit interrupters (AFCIs) in residential kitchens. AFCIs are a critical safety feature designed to detect electrical arcing and stop a potential fire before it starts. Removing this layer of protection in kitchens—where heat, appliances, and wiring converge—is dangerous and shortsighted. Kitchen fires are already one of the most common and deadly causes of home fires in the U.S. While my own burn injury in 2020 was not electrical in nature, it did happen in my kitchen while cooking—a setting where many household injuries occur. According to the American Burn Association, over 100,000 people are treated in emergency rooms each year for burn injuries related to cooking. That's not a statistic—it's a crisis that hits close to home for far too many. I suffered a 20% surface burn. I've included photos along with this statement to provide a visual reference of what that level of injury looks like. And I say this with full awareness: what I endured was mild compared to what many burn survivors face. I cannot imagine what those with 40%, 60%, or 80% burns endure. But I know firsthand the pain, the trauma, and the lifelong impact—even at 20%. You can read more about my story here: https://www.orlandohealth.com/content-hub/burn-survivor-finds-new-purpose-on-road-to-recovery Today, I use my experience to raise awareness and advocate for others. Through my podcast, Girls With Grafts (www.girlswithgrafts.com), I speak with survivors—many of whom suffered electrical burns due to residential fires. Their stories are tragic, and often, their injuries were preventable with better safeguards in place. You can also see part of my personal healing journey here: https://www.instagram.com/p/DIeX4hDIP4O/ We cannot afford to weaken protections that help prevent fires—especially in high-risk areas like kitchens. AFCIs have been a proven solution for more than 25 years and are required in many states for good reason. Florida should not roll back safety for the sake of convenience or cost-cutting. Please vote NO on the proposal to remove kitchens from the 210.12 requirement. Let's keep safety—and people—at the center of our building codes. With deep gratitude, Amber Wilcox awilcox429@gmail.com 27 Blockhouse Ct Ormond Beach, FL 32174

E12324Text Modification

NEC **210.12(A) Dwelling Units.**

All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in dwelling unit ~~kitchens~~, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, laundry areas, or similar rooms or areas shall be protected by any of the means described in **210.12(A)(1)** through (6):

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E12324-G2General Comment

Page: 1

Mod_12324_G2_General_Untitled design (4).pdf

Arc-Fault Circuit Interrupters and Home Appliances

Prepared by:

NEMA Low Voltage Distribution Equipment Section
National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, Virginia 22209

Introduction

Arc-fault circuit interrupters (AFCI) were introduced into the *National Electrical Code®* (NEC) in 1999 for single-phase 15A and 20A branch circuits serving bedroom branch circuit outlet receptacles to provide protection from arcing faults that can cause fires. The introduction of this technology was driven by the Consumer Product Safety Commission (CPSC) and the Electronic Industries Association (EIA) in response to concerns that the conventional circuit breaker was not providing protection of branch circuit arcing, resulting in home electrical fires and deaths, injuries, and property loss.

AFCIs undergo rigorous testing, and in addition to the product standards (circuit breaker) to which each device is listed, they are also listed to UL 1699 *Arc-Fault Circuit-Interrupters*. The NEC, which is adopted in all 50 states throughout the U.S., is updated on a three-year revision cycle through a consensus-based development process. Subsequent NEC editions since the 1999 NEC have increased the number of locations where AFCIs are required. It was the 2014 edition of the NEC that added kitchens and laundries, where many cord and plug connected appliances are used on 120V single-phase 15A and 20A circuits.

This paper discusses the 15A and 20A AFCI protection of branch circuits that are utilized by cord and plug connected appliances and will provide perspective on the breadth of appliances currently protected by AFCIs. This will include a review of the number and types of appliances that are being protected along with how that data is determined. A review of the testing procedures and types of appliances tested will also be detailed in this document along with the number of test cases. Finally, a 2022 electrical contractor survey conducted by the Electrical Safety Foundation International (ESFI) on AFCI- and GFCI-protected circuits in the Commonwealth of Massachusetts will be presented [1]. The details of the ESFI research results will be addressed as they pertain to the topic of this paper.

Appliance Installations

The National Association of Home Builders (NAHB) publishes the number of 1- to 2-family homes and multi-family units built within the U.S. on a state-by-state basis. According to NAHB data, there were over 11 million dwelling units built since 2014. Over 9.5 million of those dwelling units were built in states where a majority of cord/plug appliances are protected by AFCIs.

Review of this data, coupled with the percentage of various appliances per home as found via a Statista November 2022 survey report [2], reveals that over 60 million appliances are protected by AFCIs. This is a very conservative number, as it does not include older homes that have been upgraded during the period of 2014 through 2022. Examples of the percentage of homes containing specific appliances are dishwashers (56%), refrigerators (83%), microwaves (84%), vacuums (76%), and washing machines (74%).

Unwanted Tripping

Unwanted tripping can manifest itself for many reasons that could include identification of wiring problems or lack of compatibility with a connected load. The American Circuit Breaker Manufacturers Association (ACBMA) reports [3] that received calls on AFCIs tripping is at 0.0078% of AFCIs shipped. These reports collect data that includes questions on selection, wiring, application, and tripping. Reports have revealed that tripping incidents are split between overload/short circuit and arc fault, with a large majority being overload/short circuit. In reviewing this research data and comparing this data to the number of appliances that are reported to trip AFCIs, it is found that claims and statements made related to compatibility being the vast majority of AFCI unwanted tripping incidents are not substantiated.

NEMA received 35 reports of unwanted tripping through the AFCIsafety.org website in 2021 through 2022, and none of the reported unwanted tripping issues identified a faulty circuit breaker or an incompatible product issue. There are, however, 10 submissions where the customer has not responded to the investigation. It would be fair to question why the actual documentation of reported AFCI tripping concerns does not match that which is claimed by certain industry groups.

One of the reasons AFCI technology has performed and continues to perform well is because of the partnerships between AFCI manufacturers and their customers, who together are able to identify applications and practical application examples that facilitate AFCI manufacturer interoperability tests with a variety of appliances and appliance combinations. These home appliance lab emulations conduct over 130,000 test cases covering over 400 appliance brands and 150 product types. There is also an additional testing done for over 40,000 combination loads such as various countertop appliances, vacuum cleaners, power tools, and durable medical equipment. The lab tests use loading, temperature, humidity, and other factors to change the parameters to provide as many options as possible to determine if an AFCI will trip when protecting the circuit where an appliance or group of appliances is installed. The results of these extensive tests are AFCIs that function properly with appliances.

Figure 1 Courtesy of Schneider Electric

Figure 2 Courtesy of Schneider Electric

ESFI Electrical Contractor Survey

The Electrical Safety Foundation International (ESFI) conducted a survey of electrical contractors asking about how AFCI and GFCI devices performed in homes in Massachusetts. The Commonwealth of Massachusetts has had a requirement for all 120VAC 15A-20A receptacles to be protected by AFCIs since January 1, 2020. The respondents stated that they make an average of 27 total service calls per week. The contractors concluded that 59% of these calls were related to tripped circuit breakers or fuses. In reviewing the responses on circuit breaker calls, the breakdown of results includes the following:

- 68% of the service calls were related to overload/short circuit trips
- 18% of the service calls were AFCI trips
- 10% of the service calls were GFCI trips
- 4% of the service calls were defective products

Further investigation of the results of the service calls found that the most common mistakes identified by electrical contractors included the following:

- 37% were wiring issues
- 32% were related to the lack of or inadequate GFCI protection
- 27% overloaded circuits
- 2% other causes

There were no documented issues related to AFCIs from what was found on these service calls. ESFI also attempted to survey homeowners who live in homes built since January 1, 2020, but did not receive statistically significant results. The initial findings showed that AFCI devices work as designed to detect faults in appliances and wiring, but more research is required.

Summary

In conclusion, data shows that AFCIs are protecting over 60 million appliances with a very small number of documented reports of unwanted tripping. The claims around high amounts and percentages of unwanted tripping have been anecdotal; lack details on when, where, and why occurrences are happening; and do not constitute facts around AFCI and appliance compatibility performance. These are clearly unsubstantiated statements in light of the data provided in this document.

The amount of testing done to verify that AFCIs will work with various appliances is extensive and goes far beyond what the product safety standard requires to make sure homeowners receive the best protection from fires with the installation of AFCIs. In addition, the ESFI survey shows that most tripping reports and issues are overloads and short circuits. The absence of any AFCI reported unwanted tripping issues from a state that requires them to protect most, if not all, of the receptacles found in the house provides further data that AFCIs are functioning properly. This data provides specific information on the successful safety protection of branch circuits by AFCIs when loads are appliances or other devices.

References

[1] *ESFI Arc-Fault Circuit Interrupter (AFCI) and Ground Fault Circuit Interrupter (GFCI) Performance Survey*, ESFI, 2022

[2] *Household appliances ownership in the U.S. in 2022*, Alexander Kunst, Statista, 2022

[3] *NEC® CMP-2 ACBMA Presentation,* American Circuit Breaker Manufacturing Association (ACBMA), October 2018

EC&M

NATIONAL ELECTRICAL CODE

Lowering Home Costs Should Not Abandon National Electrical Safety Requirements

The path to making new homes more affordable should not come at the expense of eliminating electrical safety requirements.

Todd Sims

A recent story in *EC&M* attempted to draw a connection between the home affordability crisis and improvements to the National Electrical Code (NEC) that help prevent electrical shocking, electrocution, and electrical fires. The article highlights efforts by various industry groups to strip out essential consumer protections from the NEC, namely AFCI, GFCI, and surge protection.

Housing affordability is a concern nationwide, but to be clear, the path to making new homes more affordable should not come at the expense of eliminating proven electrical safety requirements that protect public health and safety.

A recent, in-depth story from YahooFinance! specifically addressed the root causes of the U.S. housing affordability situation, pointing to ongoing supply chain problems and rapidly rising wages for construction workers leading to higher homebuilding costs.

It also cited additional impacts on those costs including a struggling economy; current homeowners holding onto their properties purchased when interest rates were low; and potential homebuyers shying away from new construction due to less than desirable and much higher mortgage rates. Experts interviewed for the story also concluded that “the main reason home prices are so high in the U.S. is the relatively low inventory.” It is worth noting that nowhere in the story does it mention electrical safety requirements as being part of the problem.

Professional, licensed and certified electrical contractors and electricians know exactly how important the NEC requirements are and support them. Safety is always a number one priority with these trained men and women who work tirelessly in the field to add safety, value and protection for individuals and families long after they have left the job site. Their work and the NEC standards they adhere to should be respected for the incredible value they bring to someone building a new home. Protecting contractors, installers, and homebuilders during the time of construction must be included in the cost-benefit analysis of adding additional protections.

The electrical industry understands that these requirements are there for good reason: they provide for the safe installation of electrical wiring and equipment and above all protect the consumer. Published by the National Fire Protection Association (NFPA), the NEC is revised every three years to make sure it is up to date, representing the latest in safety methods and technology. It is further incorporated into everything the electrical community does when building and renovating homes and commercial buildings.

The average cost to build a new home in 2025, depending on where you live, ranges from $110,000 to $550,000, per Houzeo.com. The average cost to protect a 2,000 sq ft home from electrical shocking/electrocution (GFCIs), electrical fires (AFCIs), and electrical surging (SPDs) combined is between $1,000 to $1,500. That's less than .75% of the total cost of a $200,000 home and, spread over a 30-year mortgage, about $4.15 per month to fully protect the occupants.

Some stakeholders contend it would be better to just get rid of, or scale back, these NEC safety requirements rather than protect a family for decades. That type of thinking does a disservice to the public that believes they are getting homes built to the highest safety standards when, in reality, they are not. It does not make common sense, and it sets a precedent that should concern everyone if homes start being built without national safety standards that comply with the most updated NEC. This is especially concerning as insurance rates skyrocket across the nation. Nationally, insurance premiums rose 11.3% in 2023 and shot up 33.8% from 2018 to 2023, according to S&P Global Market Intelligence. The reduction of or removal of NEC safety requirements can only serve to increase insurance premiums, further impacting home affordability.

As the International Brotherhood of Electrical Workers stated in *EC&M*'s story, safety and affordability can co-exist in this case.

There needs to be an open and honest discussion between the electrical and construction industries to reinforce why NEC safety requirements matter and how to address other factors that are actually impacting cost. All interested parties can come together to ensure homes are safe, affordable, and resilient.

Source URL: https://www.ecmweb.com/national-electrical-code/article/55270514/lowering-home-costs-should-not-abandon-national-electrical-safety-requirements

E12324-G1General Comment

Mod_12324_G1_General_AFCI INFOGRAPHIC - NEMA 2024.pdf Page: 1

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Building

E11954

12

Date Submitted	02/10/2025	**Section**	102.4	**Proponent**	Bryan Holland
Chapter	35	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

A related modification has been submitted to the FBC-R to update the reference to NFPA 70-23, including all published TIAs.

Summary of Modification

This proposed modification recommends adoption of NFPA 70-23, including all published Tentative Interim Amendments (TIAs)

Rationale

This proposed modification recommends updating the adopted edition of NFPA 70 to the 2023 edition, including all published TIAs (TIA 23-1 through TIA 23-16). Tentative Interim Amendments (TIAs) are important revisions to the code that have been issued by the NFPA Standards Council after publication of the document. All issued TIAs have been reviewed and approved through consensus voting on the basis of "technical merit" and "emergency nature" by the corresponding Code Making Panel, without creating a correlation issue with any other sections of the code. For the 2023 edition of NFPA 70, TIAs 23-1 through 23-6 were issued prior to publication of the code and incorporated into the first printing. This proposed modification recommends all TIAs, 23-1 through 23-16 be officially adopted and incorporated into the code. This will help reduce conflicts in the field and improve consistent enforcement across all Florida jurisdictions.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

This proposed modification will improve the consistent enforcement of the code by the local entity.

Impact to building and property owners relative to cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Impact to industry relative to the cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Impact to small business relative to the cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The changes made to the 2023 NEC along with all issued TIAs represent important improvements and corrections to the published code. All (16) TIAs have been deemed to have both technical merit and emergency in nature, thus increasing the health, safety, and welfare of the general public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification improves the code by updating to the most current edition of the NEC and by incorporating corrections made after initial publication.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

This proposed modification improves the effectiveness of the code.

E11954Text Modification

CHAPTER 35 REFERENCED STANDARDS

NFPA

70 - ~~20~~ 23 National Electrical Code (NEC), including all published Tentative Interim Amendments (TIAs) published until December 4, 2024

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Mod11954_TextOfModification.pdf

E11954Text Modification

NFPA

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Definition of Pool, and 680.26
TIA 23-9
(SC 23-3-8 / TIA Log #1687)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise the definition of "Pool" to read as follows:

Pool. Manufactured or field-constructed equipment designed to contain water on a permanent or semipermanent basis and used by persons for swimming, wading, immersion, or therapeutic purposes, but not including bodies of water incorporated as part of an industrial process or lakes, lagoons, surf parks, or other natural and man-made bodies of water that may incorporate swimming and swimming areas. (680) (CMP-17)

Informational Note: Natural and man-made bodies of water, which includes lakes, lagoons, surf parks, or other similar bodies of water, are addressed in Article 682.

2. Revise section paragraph 680.26 to read as follows:

680.26 Equipotential Bonding.

(A) Performance. The equipotential bonding required by 680.26(B) and (C) to reduce voltage gradients in the pool area shall be installed for pools with or without associated electrical equipment related to the pool.

Informational Note No. 1: Some causes of voltage gradients originate outside the premises wiring system and are not within the scope of the *NEC*. Measures identified in Rule 097D2 of ANSI C2, *National Electrical Safety Code,* can also serve to address voltage gradients originating on the utility side of the service point.

Informational Note No. 2: By its nature, equipotential bonding of swimming pools and perimeter surfaces involves contact between various metallic materials and the earth. This can, in some cases, expose various specific metals to a corrosive environment, depending on factors such as the type and chemical content of the soil and the specific metal. Corrosive environments are also addressed in 680.14.

(B) Bonded Parts. …

(1) Conductive Pool Shells. …

(2) Perimeter Surfaces. The perimeter surface to be bonded shall be considered to extend for ~~1 m~~ 900 mm (3 ft) horizontally beyond the inside walls of the pool ~~and~~ while also at a height between 900 mm (3 ft) above and 600 mm (2 ft) below the maximum water level. The perimeter surface shall include unpaved surfaces, concrete, and other types of paving. Perimeter surfaces separated from the pool by a permanent wall or building 1.5 m (5 ft) in height or more shall

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require equipotential bonding only on the pool side of the permanent wall or building. Bonding to perimeter surfaces shall be provided as specified in 680.26(B)(2)(a), (B)(2)(b), ~~or~~ (B)(2)(c), and (B)(2)(d). ~~and~~ For conductive pool shells where bonding to perimeter surfaces is required, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four points uniformly spaced around the perimeter of the pool, or if the bonded perimeter surface does not surround the entire pool, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four uniformly spaced points along the bonded perimeter surface. For nonconductive pool shells where bonding to the perimeter surfaces is required, bonding at four points shall not be required, and the perimeter bonding shall be attached to the 8 AWG copper equipotential bonding conductor and, if present, to any conductive support structure for the pool.

Informational Note: Because the perimeter surface can incorporate various types of materials at various locations and elevations above and below maximum water level, the perimeter surface required to be bonded might not surround the entire pool. The 8 AWG copper equipotential bonding conductor can encircle the entire pool to facilitate connection of bonded parts.

(a) ~~*Structural Reinforcing Steel.* Structural reinforcing steel shall be bonded in accordance with 680.26(B)(1)(a).~~ *Conductive Paved Portions of Perimeter Surfaces.* Conductive paved portions of perimeter surfaces, including masonry pavers, if used, shall be bonded with unencapsulated structural reinforcing steel in accordance with 680.26(B)(1)(a), or with unencapsulated steel structural welded wire reinforcement (welded wire mesh, welded wire fabric), bonded together by steel tie wires or the equivalent. Steel welded wire reinforcement shall be fully embedded within the pavement unless the pavement will not allow for embedding. If the reinforcing steel is absent, or is encapsulated in a nonconductive compound, or embedding is not possible, unencapsulated welded wire steel reinforcement or a copper conductor grid shall be provided and shall be secured directly under the paving, and not more than 150 mm (6 in.) below finished grade.

Unencapsulated steel welded wire reinforcement that is not fully embedded in concrete, and copper grid regardless of location, where used for equipotential bonding, shall be listed for corrosion resistance and mechanical performance. This listing requirement shall become effective January 1, 2025. The copper grid or unencapsulated steel welded wire reinforcement shall also meet the following:

(1) Copper grid is constructed of 8 AWG solid bare copper and arranged in accordance with 680.26(B)(1)(b)(3).
(2) Steel welded wire reinforcement is minimum ASTM 6x6-W2.0 x W2.0 or minimum No. 3 rebar constructed in a 300 mm (12 in.) grid.
(3) Copper grid and steel welded wire reinforcement follow the contour of the perimeter surface extending not less than 900 mm (3 ft) horizontally beyond the inside walls of the pool.
(4) Only listed splicing devices or exothermic welding are used.

Informational Note No. 1: Performance of the equipotential bonding system at the perimeter surface is improved as the distance between the bonding means and finished grade is minimized, either by embedding within, or by direct contact with the underside of, the finished pavement.

Informational Note No. 2: See ASTM A615/A615M, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement;* A1064/A1064M, *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete;* A1022/A1022M, *Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement;* A1060A/A1060M, *Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete;* and ACI Standard ACI 318, *Building Code Requirements for Structural Concrete,* for examples of standards currently used in the listing of reinforcing steel bars and steel welded wire reinforcement.

(b) *Unpaved Portions of Perimeter Surfaces.* Unpaved portions of perimeter surfaces shall be bonded with any of the following methods:
(1) ~~*Copper Ring.* Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, a c~~Copper conductor(s) shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. At least one minimum 8 AWG bare solid copper conductor, including the 8 AWG copper equipotential bonding conductor if available ~~shall be provided~~.
~~(2)~~b. The conductors ~~shall~~ follow the contour of the perimeter surface.
~~(3)~~c. Only listed splicing devices or exothermic welding are used. ~~shall be permitted.~~
~~(4)~~d. The ~~required~~ conductor(s) is ~~shall be~~ 450 mm to 600 mm (18 in. to 24 in.) from the inside walls of the pool.
~~(5)~~e. The ~~required~~ conductor(s) ~~shall be secured within or~~ is under the unpaved portion of the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.
f. Be installed only in perimeter surfaces not intended to have direct access to swimmers in the pool.

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(~~c~~2) ~~*Copper Grid*. Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound,~~ ~~c~~Copper grid or unencapsulated steel welded wire reinforcement used for equipotential bonding of unpaved portions of perimeter surfaces shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. ~~The copper grid shall be constructed of 8 AG solid bare copper and be arranged~~ Be installed in accordance with 680.26~~(B)(1)(b)(3)~~(B)(2)(a).
~~(2) The copper grid shall follow the contour of the perimeter surface extending 1 m (3 ft) horizontally beyond the inside walls of the pool.~~
~~(3) Only listed splicing devices or exothermic welding shall be permitted.~~
~~(4)~~b. ~~The copper grid shall be secured~~ Be located within ~~or under~~ the ~~deck or~~ unpaved surface(s) between 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.

(c*) Nonconductive Perimeter Surfaces.* Equipotential bonding shall not be required for nonconductive portions of perimeter surfaces that are separated from earth or raised on nonconducting supports, and it shall not be required for any perimeter surface that is electrically separated from the pool structure and raised on nonconductive supports above an equipotentially bonded surface.

> Informational Note: Nonconductive materials include, but are not limited to, wood, plastic, wood-plastic composites, fiberglass, and fiberglass composites.

(d*) Interconnection of Bonded Portions of Perimeter Surfaces.* All surfaces where equipotential bonding is required shall be interconnected using listed splicing devices or exothermic welding. Where copper wire is used for this purpose, it shall be solid copper, not smaller than 8 AWG. The conductor shall be permitted to encircle the pool to facilitate bonding connections to portions of the perimeter covered in 680.26(B)(2)(a) and (B)(2)(b) that are not contiguous.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 300.26
TIA 23-8
(SC 23-3-9 / TIA Log #1688)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by the NEC Code-Making Panel 3 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 300.26 to read as follows:

300.26 Remote-Control and Signaling Circuits Classification.
Remote-control and signaling circuits shall be classified as either power-limited or non-power-limited and comply with ~~the following~~300.26(A) through (C).

(~~1~~A) **Class 1 Power-Limited Remote-Control and Signaling Circuits**. Class 1 power-limited remote-control and signaling circuits shall comply with 724.3.

(~~2~~B) **Class 2 and Class 3 Power-Limited Remote-Control and Signaling Circuits**. Class 2 and Class 3 power-limited remote-control and signaling circuits shall comply with 725.3.

(~~3~~C) **Non-Power-Limited Remote-Control and Signaling Circuits**. Non-power-limited remote-control and signaling circuits shall be installed in accordance with 300.2 through 300.25 and comply with 300.26(C)(1) through (C)(3).

(1) Sizes and Use.

(a) Conductors that are 18 AWG and 16 AWG copper shall be permitted to be used if they supply loads that do not exceed the ampacities specified in 402.5 and are installed in a raceway, an approved enclosure, or a listed cable.

(b) Conductors that are 14 AWG copper-clad aluminum shall be permitted to be used in Type MC cable and Type TC cable. The continuous load shall not exceed 8 amperes.

(c) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall not supply loads greater than the ampacities specified in 310.14.

(d) Flexible cords shall comply with the applicable general requirements, applications, and construction specifications for flexible cords and flexible cables in accordance with Article 400 Parts I and II.

(2) Insulation.

(a) Insulation on conductors shall be rated for the system voltage and not less than 600 volts.

(b) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall comply with the applicable general requirements for conductors rated up to and including 2000 volt for type designations, insulations, markings, ampacity ratings, and uses in accordance with 310.3, 310.4, 310.6, 310.8, 310.10, and 310.14.

(c) Conductors that are 18 AWG copper, 16 AWG copper, or 14 AWG copper-clad aluminum shall be Type FFH-2, Type KF-2, Type KFF-2, Type PAF, Type PAFF, Type PF, Type PFF, Type PGF, Type PGFF, Type PTF, Type PTFF, Type RFH-2, Type RFHH-2, Type RFHH-3, Type SF-2, SFF-2, Type TF, Type TFF, Type TFFN, Type TFN, Type ZF, or Type ZFF.

(d) Conductors with other types and thicknesses of insulation shall be permitted if listed for Class 1 circuit use.

(3) Overcurrent Protection.

(a) Overcurrent protection for conductors 14 AWG copper and larger shall be provided in accordance with the conductor ampacity, without applying the ampacity adjustment and correction factors specified in 310.15 to the ampacity calculation.

(b) Overcurrent protection shall not exceed 7 amperes for 18 AWG copper conductors and 10 amperes for 16 AWG copper and 14 AWG copper-clad aluminum.

Exception: The overcurrent protection specified in 300.26(C)(3)(1) and 300.26(C)(3)(2) shall not be required where this Code requires or permits other overcurrent protection ratings.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo**)**

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Reference: Table C.18, Table C.19 and Table C.20
TIA 23-7
(SC 22-12-7 / TIA Log #1678)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 8, and the NEC Correlating Committee, and was issued by the Standards Council on December 8, 2022, with an effective date of December 28, 2022.

*1. Revise Table Headers **only** for Table C.18, Table, C.19 and Table C.20 to read as follows:*

Table C.18 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.19 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.20 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

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Issue Date: December 8, 2022

Effective Date: December 28, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 555.35
TIA 23-6
(SC 22-8-23 / TIA Log #1660)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.35 to read as follows:

555.35 Ground-Fault Protection of Equipment (GFPE) and Ground-Fault Circuit Interrupter. For other than floating buildings, ground-fault protection for docking facilities shall be provided in accordance with 555.35(A) through (~~F~~D).

~~**(A) Sources Directly Supplying Docking Facilities or Wharfs.** Listed GFPE, rated not more than 100 milliamperes, shall be provided for sources directly supplying all docking facilities or wharfs. Coordination with downstream GFPE shall be permitted.~~

(~~B~~A) Feeder. …

Exception: Transformer secondary conductors of a separately derived system that do not exceed 3 m (10 ft) and are installed in a raceway shall be permitted to be installed without ground-fault protection. This exception shall also apply to the supply terminals of the equipment supplied by the transformer secondary conductors.

(~~C~~B) Branch-Circuits.

(1) Receptacles Providing Shore Power. …

(2) Outlets for Other than Shore Power. Outlets supplied by branch circuits not exceeding 150 volts to ground and 60 amperes, single phase, and 150 volts or less to ground, 100 amperes or less, three phase, shall be provided with GFCI protection for personnel.

Exception to (~~C~~B): Low-voltage circuits not requiring grounding, not exceeding the low-voltage contact limit and supplied by listed transformers or power supplies that comply with 680.23(A)(2) shall be permitted to be installed without ground-fault protection.

(~~D~~C) Boat Hoists. …

(~~E~~D) Leakage Current Measurement Device. …

Informational Note No. 1: …

Informational Note No. 2: …

Exception: Where the shore power equipment includes a leakage indicator and leakage alarm, a separate leakage test device shall not be required.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 555.30
TIA 23-5
(SC 22-8-22 / TIA Log #1659)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.30 to read as follows:

555.30 Electrical Equipment and Connections.

(A) General. All <u>electrical components within</u> electrical equipment (excluding wiring methods) and connections not intended for operation while submerged shall be located at least 305 mm (12 in.) above the deck of a fixed or floating structure, but not below the electrical datum plane. Conductor splices, within junction boxes identified for wet locations, utilizing sealed wire connector systems listed and identified for submersion shall be required for floating structures where located above the waterline but below the electrical datum plane.

(B) Replacements. …

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 215.15
TIA 23-4
(SC 22-8-18 / TIA Log #1655)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 215.15 to read as follows:

215.15 Barriers. Barriers shall be placed such that no energized, uninsulated, ungrounded busbar or terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations in panelboards, switchboards, switchgear, or motor control centers supplied by feeder taps in 240.21(B) or transformer secondary conductors in 240.21(C) when the disconnecting device, to which the tap conductors are terminated, is in the open position.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 210.8(F) and Exception No. 2(new)
TIA 23-3
(SC 22-8-17 / TIA Log #1654)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 210.8(F) to read as follows:

210.8(F) Outdoor Outlets.

For dwellings, all outdoor outlets, other than those covered in 210.8(A), Exception No. 1, including outlets installed in the following locations, and supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, shall be provided with GFCI protection:

(1) Garages that have floors located at or below grade level
(2) Accessory buildings
(3) Boathouses

If equipment supplied by an outlet covered under the requirements of this section is replaced, the outlet shall be supplied with GFCI protection.

Exception No. 1: GFCI protection shall not be required on lighting outlets other than those covered in 210.8(C).

Exception No. 2: GFCI protection shall not be required for listed HVAC equipment. This exception shall expire September 1, 2026.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: Article 100 (Ignitible Fibers/Flyings), 506.5, and 506.9(B)
TIA 23-2
(SC 22-4-8 / TIA Log #1617)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise Article 100 Ignitible Fibers/Flyings to read as follows:

Ignitible Fibers/Flyings. Fibers/flyings where any dimension is greater than 500 μm in nominal size, which are not likely to be in suspension in quantities to produce an explosible mixture, but could produce an ignitible layer fire hazard. [**499:**3.3.4.2]

Informational Note No.1: This definition and Informational Note No. 2 have been extracted from NFPA 499-2021, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.* The NFPA 499 reference is in brackets. Only editorial changes were made to the extracted text to make it consistent with this *Code.*

Informational Note No. 2: Section 500.5 of this *Code* prescribes a Class III location as one where ignitible fibers/flyings are present, but not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. This description addresses fibers/flyings that do not present a flash-fire hazard or explosion hazard by test. This could be because those fibers/flyings are too large or too agglomerated to be suspended in air in sufficient concentration, or at all, under typical test conditions. Alternatively, this could be because they burn so slowly that, when suspended in air, they do not propagate combustion at any concentration. In this document the zone classification system includes ignitible fibers/flyings as a fire hazard in a layer, which is not addressed in the IEC zone system (see IEC 60079-10-2, *Explosive atmospheres — Part 10-2: Classification of areas — Explosive dust atmospheres*). Where these are present, the user could also consider installation in accordance with Article 503 of this *Code.* [**499:**A.3.3.4.2]

2. Revise Section 506.5 to read as follows:

506.5 Classification of Locations.
(A) Classifications of Locations. …
(B) Zone 20, Zone 21, and Zone 22 Locations. …
(1) Zone 20. A Zone 20 location is a location where one of the following apply:
(1) Ignitible concentrations of combustible dust, ~~or~~ combustible fibers/flyings, or ignitible fibers/flyings are present continuously or for long periods of time.
…
(2) Zone 21. …
(3) Zone 22. A Zone 22 location is a location where one of the following apply:
(1) …
(2) Combustible dust, combustible fibers/flyings, or ignitible fibers/flyings are handled, processed, or used…
(3) …

3. Revise Section 506.9(B) to read as follows:

506.9 Equipment Requirements.
…

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(B) Listing. Equipment that is listed for Zone 20 shall be permitted in a Zone 21 or Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying. Equipment that is listed for Zone 21 ~~can be used~~ shall be permitted in a Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying.

Issue Date: April 12, 2022

Effective Date: May 2, 2022

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Reference: 680.43, Exception No. 3
TIA 23-16
(SC 24-12-6 / TIA Log #1800)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17, and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on December 4, 2024, with an effective date of December 24, 2024.

1. Delete Exception No. 3 of 680.43 as follows:

680.43 Indoor Installations. A spa or hot tub installed indoors shall comply with the provisions of Parts I and II of this article except as modified by this section and shall be connected by the wiring methods of Chapter 3.

Exception No. 1: Listed spa and hot tub …

Exception No. 2: The equipotential bonding …

~~*Exception No. 3: For a dwelling unit(s) only, where a listed spa or hot tub is installed indoors, the wiring method requirements of 680.42(C) shall also apply.*~~

Issue Date: December 4, 2024

Effective Date: December 24, 2024

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 210.70
TIA 23-15
(SC 23-11-10/ TIA Log #1753)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 2, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 210.70 to read as follows:

210.70 Lighting Outlets Required. Lighting outlets shall be installed where specified in 210.70(A), (B), and (C). The switch or listed wall-mounted control device shall not rely exclusively on ~~a~~ battery power unless ~~a~~ it incorporates a positive means of notification of impending battery depletion. ~~is provided for automatically energizing the lighting outlets upon battery failure.~~

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 517.30(B)(3)(a)
TIA 23-14
(SC 23-11-9 / TIA Log #1752)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 15, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 517.30(B)(3)(a) to read as follows:

517.30(B)(3) Fuel Cell Systems. Fuel cell systems shall be permitted to serve as the alternate power source for all or part of an EES. [**99:**6.7.1.5.1]

(a) Installation of fuel cells shall comply with the requirements in Parts I through VI ~~VII~~ of Article 692~~ for 1000 volts or less and Part VIII for over 1000 volts~~.

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 400.47
TIA 23-13
(SC 23-8-57 / TIA Log #1731)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by Code-Making Panel 6 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise section 400.47 to read as follows:

400.47. ~~Minimum~~ Conductor Bending ~~Radii~~ Radius. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 2000 volts to 5000 volts shall not ~~exceed~~ be bent to a radius less than six times the overall cable outer diameter. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 5001 volts to 25,000 volts shall not ~~exceed~~ be bent to a radius less than eight times the overall cable outer diameter.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 408.6
TIA 23-12
(SC 23-8-56 / TIA Log #1699)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by Code-Making Panel 9 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 408.6 to read as follows:

408.6 Short-Circuit Current Rating. Switchboards, switchgear, and panelboards shall have a short-circuit current rating not less than the available fault current. In other than one- and two-family dwelling units, the available fault current and the date the calculation was performed shall be field marked on the enclosure at the point of supply. The marking shall <u>be of sufficient durability to withstand the environment involved.</u> ~~comply with 110.21(B)(3).~~

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 700.32(C), 701.32(C), and 708.54(C)
TIA 23-11
(SC 23-8-54 / TIA Log #1692)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by Code-Making Panel 13 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 700.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

700.32 Selective Coordination.

700.32(A) General. Emergency system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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

700.32(B) Replacements. Where emergency system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

700.32(C) Modifications. If modifications, additions, or deletions to the emergency system(s) occur, selective coordination of the emergency system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 700.32~~(C)~~ for an example of how emergency system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~

~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~

~~OCPD F selectively coordinates with OCPD E.~~

~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.~~

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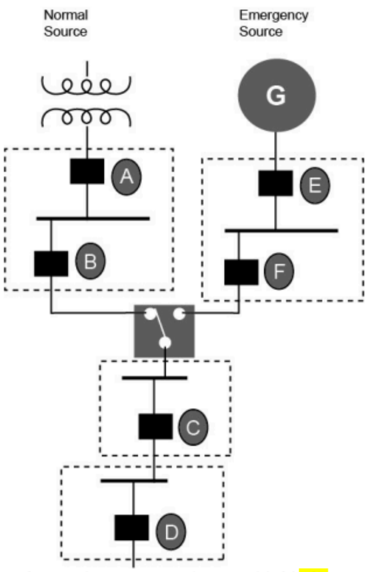
Mod_11954_Text_TIA 23-11.pdf

E11954Text Modification



Informational Note Figure 700.32~~(C)~~ Emergency System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.

2. Revise 701.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

701.32 Selective Coordination.

701.32(A) General. Legally required standby system(s) overcurrent protective devices (OCPDs shall be selectively coordinated with all supply-side and load-side OCPDs.

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

701.32(B) Replacements. Where legally required standby OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

701.32(C) Modifications. If modifications, additions, or deletions to the legally required standby system(s) occur, selective coordination of the legally required system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 701.32~~(C)~~ for an example of how legally required standby system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.~~

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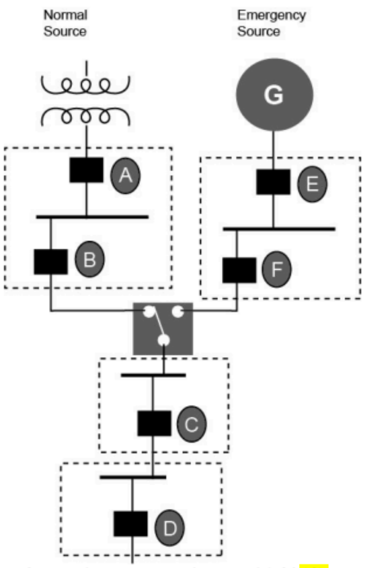
E11954Text Modification



Informational Note Figure 701.32~~(C)~~ Legally Required Standby System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.

3. Revise 708.54(C) Informational Note and title of Figure for the Informational Note to read as follows:

708.54(A) General. Critical operations power system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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

708.54(B) Replacements. Where critical operations power system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

708.54(C) Modifications. If modifications, additions, or deletions to the critical operations power system(s) occur, selective coordination of the critical operations power system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 708.54~~(C)~~ for an example of how critical operations power system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.~~

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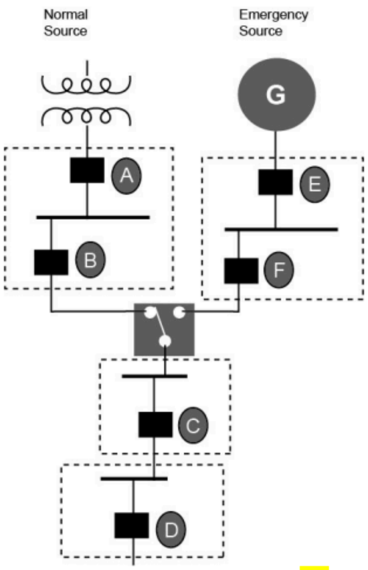
Mod_11954_Text_TIA 23-11.pdf

E11954Text Modification



Informational Note Figure 708.54~~(C)~~ Critical Operations Power System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Mod_11954_Text_TIA 23-11.pdf

E11954Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 314.29(A)
TIA 23-10
(SC 23-3-10 / TIA Log #1690)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 9 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 314.29(A) to read as follows:

314.29 Boxes, Conduit Bodies, and Handhole Enclosures to Be Accessible. Boxes, conduit bodies, and handhole enclosures shall be installed so that wiring and devices contained in the boxes, conduit bodies, or handhole enclosures can be rendered accessible in accordance with 314.29(A) and (B).

(A) In Buildings and Other Structures. Boxes and conduit bodies shall be installed so the contained wiring and devices are accessible. Boxes and conduit bodies that are recessed into or behind finished surfaces of buildings shall have access to their internal contents maintained by openings in their covers and in the building finish that comply with 314.29(A)(1), (A)(2), or (A)(3) as applicable. Removable finished covers and faceplates that maintain this access shall be permitted.

(1) Boxes 1650 cm³ (100 in.³) or Less in Size. The openings in the building surfaces, if reduced from the outer walls of the box, shall be centered not more than 25 mm (1 in.) from the centerline of the box, and shall not extend beyond the walls of the box. If rectangular, the opening shall be not less than 73 mm (2 7/8 in.) by 45 mm (1 3/4 in.) in size. If circular, the opening shall not be less than 90 mm (3½ in.) in diameter.

Exception: Smaller openings in building surfaces that accommodate one or more individual devices shall be permitted if all of the following conditions are met:

(1) The outlet box that supplies the device(s) is nonmetallic.
(2) The branch circuit wiring that supplies each device consists of a separate nonmetallic cable assembly originating outside the box, or individual sets of conductors in a single nonmetallic raceway, all of which originate outside the box. Other than the connections to a single device, these conductors are not spliced in the box or continued to another device, and no other wiring or raceways enter the box.
(3) Each device is capable of removal from the building surface opening without being damaged. If a special tool is required for this purpose, the applicable circuit directory for the device records the location of the tool, together with a product code/QR code for acquiring a replacement if necessary.
(4) All connections for each device to the branch circuit wiring are made with listed clamping-type wire connectors, which are supplied with the devices. The branch-circuit conductors are arranged to permit the connector(s) to be exposed after the device has been fully removed.
(5) The device assemblies are listed for this application.

(2) Boxes Larger Than 1650 cm³ (100 in.³) in Size. The openings shall not be smaller than the outer walls of the box.
(3) Conduit Bodies. The openings shall not be smaller than outer walls of the conduit body.
(B) Underground. Underground boxes and handhole enclosures shall be installed …

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Mod_11954_Text_TIA 23-10.pdf

E11954Text Modification

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Mod_11954_Text_TIA 23-10.pdf

E11954Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 250.114(3)e and 250.114(4)e
TIA 23-1
(SC 21-12-13 / TIA Log #1608)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise 250.114(3)e and (4)e to read as follows:

250.114 Equipment Connected by Cord and Plug. Exposed, normally non-current-carrying metal parts of cord-and-plug-connected equipment shall be connected to the equipment grounding conductor under any of the following conditions:

…

(3) In residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

(4) In other than residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

…

Issue Date: December 8, 2021

Effective Date: December 28, 2021

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Mod_11954_Text_TIA 23-1.pdf

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Energy Conservation

EN12024

13

Date Submitted	02/11/2025	**Section**	106.1	**Proponent**	Bryan Holland
Chapter	6	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

A related modification has been submitted to the FBC-B and FBC-R to update the reference to NFPA 70-23, including all published TIAs.

Summary of Modification

This proposed modification recommends adoption of NFPA 70-23, including all published Tentative Interim Amendments (TIAs)

Rationale

This proposed modification recommends updating the adopted edition of NFPA 70 to the 2023 edition, including all published TIAs (TIA 23-1 through TIA 23-16). Tentative Interim Amendments (TIAs) are important revisions to the code that have been issued by the NFPA Standards Council after publication of the document. All issued TIAs have been reviewed and approved through consensus voting on the basis of "technical merit" and "emergency nature" by the corresponding Code Making Panel, without creating a correlation issue with any other sections of the code. For the 2023 edition of NFPA 70, TIAs 23-1 through 23-6 were issued prior to publication of the code and incorporated into the first printing. This proposed modification recommends all TIAs, 23-1 through 23-16 be officially adopted and incorporated into the code. This will help reduce conflicts in the field and improve consistent enforcement across all Florida jurisdictions.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
This proposed modification will improve the consistent enforcement of the code by the local entity.
Impact to building and property owners relative to cost of compliance with code
This proposed modification will not change the cost of compliance with code.
Impact to industry relative to the cost of compliance with code
This proposed modification will not change the cost of compliance with code.
Impact to small business relative to the cost of compliance with code
This proposed modification will not change the cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The changes made to the 2023 NEC along with all issued TIAs represent important improvements and corrections to the published code. All (16) TIAs have been deemed to have both technical merit and emergency in nature, thus increasing the health, safety, and welfare of the general public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification improves the code by updating to the most current edition of the NEC and by incorporating corrections made after initial publication.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

This proposed modification improves the effectiveness of the code.

EN12024Text Modification

Chapter 6 [CE] Referenced Standards

NFPA

70 - ~~20~~ 23 National Electrical Code (NEC), including all published Tentative Interim Amendments (TIAs) published until December 4, 2024

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Mod12024_TextOfModification.pdf

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Definition of Pool, and 680.26
TIA 23-9
(SC 23-3-8 / TIA Log #1687)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise the definition of "Pool" to read as follows:

Pool. Manufactured or field-constructed equipment designed to contain water on a permanent or semipermanent basis and used by persons for swimming, wading, immersion, or therapeutic purposes, but not including bodies of water incorporated as part of an industrial process or lakes, lagoons, surf parks, or other natural and man-made bodies of water that may incorporate swimming and swimming areas. (680) (CMP-17)

> **Informational Note:** Natural and man-made bodies of water, which includes lakes, lagoons, surf parks, or other similar bodies of water, are addressed in Article 682.

2. Revise section paragraph 680.26 to read as follows:

680.26 Equipotential Bonding.

(A) Performance. The equipotential bonding required by 680.26(B) and (C) to reduce voltage gradients in the pool area shall be installed for pools with or without associated electrical equipment related to the pool.

> Informational Note No. 1: Some causes of voltage gradients originate outside the premises wiring system and are not within the scope of the *NEC*. Measures identified in Rule 097D2 of ANSI C2, *National Electrical Safety Code*, can also serve to address voltage gradients originating on the utility side of the service point.

> Informational Note No. 2: By its nature, equipotential bonding of swimming pools and perimeter surfaces involves contact between various metallic materials and the earth. This can, in some cases, expose various specific metals to a corrosive environment, depending on factors such as the type and chemical content of the soil and the specific metal. Corrosive environments are also addressed in 680.14.

(B) Bonded Parts. …

(1) Conductive Pool Shells. …

(2) Perimeter Surfaces. The perimeter surface to be bonded shall be considered to extend for ~~1 m~~ 900 mm (3 ft) horizontally beyond the inside walls of the pool ~~and~~ while also at a height between 900 mm (3 ft) above and 600 mm (2 ft) below the maximum water level. The perimeter surface shall include unpaved surfaces, concrete, and other types of paving. Perimeter surfaces separated from the pool by a permanent wall or building 1.5 m (5 ft) in height or more shall

require equipotential bonding only on the pool side of the permanent wall or building. Bonding to perimeter surfaces shall be provided as specified in 680.26(B)(2)(a), (B)(2)(b), ~~or~~ (B)(2)(c), and (B)(2)(d). ~~and~~ For conductive pool shells where bonding to perimeter surfaces is required, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four points uniformly spaced around the perimeter of the pool, or if the bonded perimeter surface does not surround the entire pool, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four uniformly spaced points along the bonded perimeter surface. For nonconductive pool shells where bonding to the perimeter surfaces is required, bonding at four points shall not be required, and the perimeter bonding shall be attached to the 8 AWG copper equipotential bonding conductor and, if present, to any conductive support structure for the pool.

Informational Note: Because the perimeter surface can incorporate various types of materials at various locations and elevations above and below maximum water level, the perimeter surface required to be bonded might not surround the entire pool. The 8 AWG copper equipotential bonding conductor can encircle the entire pool to facilitate connection of bonded parts.

(a) ~~*Structural Reinforcing Steel.* Structural reinforcing steel shall be bonded in accordance with 680.26(B)(1)(a).~~ *Conductive Paved Portions of Perimeter Surfaces.* Conductive paved portions of perimeter surfaces, including masonry pavers, if used, shall be bonded with unencapsulated structural reinforcing steel in accordance with 680.26(B)(1)(a), or with unencapsulated steel structural welded wire reinforcement (welded wire mesh, welded wire fabric), bonded together by steel tie wires or the equivalent. Steel welded wire reinforcement shall be fully embedded within the pavement unless the pavement will not allow for embedding. If the reinforcing steel is absent, or is encapsulated in a nonconductive compound, or embedding is not possible, unencapsulated welded wire steel reinforcement or a copper conductor grid shall be provided and shall be secured directly under the paving, and not more than 150 mm (6 in.) below finished grade.

Unencapsulated steel welded wire reinforcement that is not fully embedded in concrete, and copper grid regardless of location, where used for equipotential bonding, shall be listed for corrosion resistance and mechanical performance. This listing requirement shall become effective January 1, 2025. The copper grid or unencapsulated steel welded wire reinforcement shall also meet the following:

(1) Copper grid is constructed of 8 AWG solid bare copper and arranged in accordance with 680.26(B)(1)(b)(3).
(2) Steel welded wire reinforcement is minimum ASTM 6x6-W2.0 x W2.0 or minimum No. 3 rebar constructed in a 300 mm (12 in.) grid.
(3) Copper grid and steel welded wire reinforcement follow the contour of the perimeter surface extending not less than 900 mm (3 ft) horizontally beyond the inside walls of the pool.
(4) Only listed splicing devices or exothermic welding are used.

Informational Note No. 1: Performance of the equipotential bonding system at the perimeter surface is improved as the distance between the bonding means and finished grade is minimized, either by embedding within, or by direct contact with the underside of, the finished pavement.

Informational Note No. 2: See ASTM A615/A615M, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement;* A1064/A1064M, *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete;* A1022/A1022M, *Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement;* A1060A/A1060M, *Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete;* and ACI Standard ACI 318, *Building Code Requirements for Structural Concrete,* for examples of standards currently used in the listing of reinforcing steel bars and steel welded wire reinforcement.

(b) *Unpaved Portions of Perimeter Surfaces.* Unpaved portions of perimeter surfaces shall be bonded with any of the following methods:
(1) ~~*Copper Ring.* Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, a c~~Copper conductor(s) shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. At least one minimum 8 AWG bare solid copper conductor, including the 8 AWG copper equipotential bonding conductor if available ~~shall be provided~~.
~~(2)~~b. The conductors ~~shall~~ follow the contour of the perimeter surface.
~~(3)~~c. Only listed splicing devices or exothermic welding are used. ~~shall be permitted.~~
~~(4)~~d. The ~~required~~ conductor(s) is ~~shall be~~ 450 mm to 600 mm (18 in. to 24 in.) from the inside walls of the pool.
~~(5)~~e. The ~~required~~ conductor(s) ~~shall be secured within or~~ is under the unpaved portion of the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.
f. Be installed only in perimeter surfaces not intended to have direct access to swimmers in the pool.

EN12024Text Modification

(~~c~~2) ~~*Copper Grid*. Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound,~~ ~~c~~Copper grid or unencapsulated steel welded wire reinforcement used for equipotential bonding of unpaved portions of perimeter surfaces shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. ~~The copper grid shall be constructed of 8 AG solid bare copper and be arranged~~ Be installed in accordance with 680.26~~(B)(1)(b)(3)~~(B)(2)(a).
~~(2) The copper grid shall follow the contour of the perimeter surface extending 1 m (3 ft) horizontally beyond the inside walls of the pool.~~
~~(3) Only listed splicing devices or exothermic welding shall be permitted.~~
~~(4)~~b. ~~The copper grid shall be secured~~ Be located within ~~or under~~ the ~~deck or~~ unpaved surface(s) between 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.

(c) *Nonconductive Perimeter Surfaces.* Equipotential bonding shall not be required for nonconductive portions of perimeter surfaces that are separated from earth or raised on nonconducting supports, and it shall not be required for any perimeter surface that is electrically separated from the pool structure and raised on nonconductive supports above an equipotentially bonded surface.

Informational Note: Nonconductive materials include, but are not limited to, wood, plastic, wood-plastic composites, fiberglass, and fiberglass composites.

(d) *Interconnection of Bonded Portions of Perimeter Surfaces.* All surfaces where equipotential bonding is required shall be interconnected using listed splicing devices or exothermic welding. Where copper wire is used for this purpose, it shall be solid copper, not smaller than 8 AWG. The conductor shall be permitted to encircle the pool to facilitate bonding connections to portions of the perimeter covered in 680.26(B)(2)(a) and (B)(2)(b) that are not contiguous.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Mod_12024_Text_TIA 23-9.pdf

Tentative Interim Amendment

NFPA® 70®

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2023 Edition

Reference: 300.26
TIA 23-8
(SC 23-3-9 / TIA Log #1688)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by the NEC Code-Making Panel 3 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 300.26 to read as follows:

300.26 Remote-Control and Signaling Circuits Classification.
Remote-control and signaling circuits shall be classified as either power-limited or non-power-limited and comply with ~~the following~~300.26(A) through (C).

(~~1~~A) **Class 1 Power-Limited Remote-Control and Signaling Circuits**. Class 1 power-limited remote-control and signaling circuits shall comply with 724.3.

(~~2~~B) **Class 2 and Class 3 Power-Limited Remote-Control and Signaling Circuits**. Class 2 and Class 3 power-limited remote-control and signaling circuits shall comply with 725.3.

(~~3~~C) **Non-Power-Limited Remote-Control and Signaling Circuits**. Non-power-limited remote-control and signaling circuits shall be installed in accordance with 300.2 through 300.25 and comply with 300.26(C)(1) through (C)(3).

(1) Sizes and Use.

(a) Conductors that are 18 AWG and 16 AWG copper shall be permitted to be used if they supply loads that do not exceed the ampacities specified in 402.5 and are installed in a raceway, an approved enclosure, or a listed cable.

(b) Conductors that are 14 AWG copper-clad aluminum shall be permitted to be used in Type MC cable and Type TC cable. The continuous load shall not exceed 8 amperes.

(c) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall not supply loads greater than the ampacities specified in 310.14.

(d) Flexible cords shall comply with the applicable general requirements, applications, and construction specifications for flexible cords and flexible cables in accordance with Article 400 Parts I and II.

(2) Insulation.

(a) Insulation on conductors shall be rated for the system voltage and not less than 600 volts.

(b) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall comply with the applicable general requirements for conductors rated up to and including 2000 volt for type designations, insulations, markings, ampacity ratings, and uses in accordance with 310.3, 310.4, 310.6, 310.8, 310.10, and 310.14.

(c) Conductors that are 18 AWG copper, 16 AWG copper, or 14 AWG copper-clad aluminum shall be Type FFH-2, Type KF-2, Type KFF-2, Type PAF, Type PAFF, Type PF, Type PFF, Type PGF, Type PGFF, Type PTF, Type PTFF, Type RFH-2, Type RFHH-2, Type RFHH-3, Type SF-2, SFF-2, Type TF, Type TFF, Type TFFN, Type TFN, Type ZF, or Type ZFF.

(d) Conductors with other types and thicknesses of insulation shall be permitted if listed for Class 1 circuit use.

(3) Overcurrent Protection.

(a) Overcurrent protection for conductors 14 AWG copper and larger shall be provided in accordance with the conductor ampacity, without applying the ampacity adjustment and correction factors specified in 310.15 to the ampacity calculation.

(b) Overcurrent protection shall not exceed 7 amperes for 18 AWG copper conductors and 10 amperes for 16 AWG copper and 14 AWG copper-clad aluminum.

Exception: The overcurrent protection specified in 300.26(C)(3)(1) and 300.26(C)(3)(2) shall not be required where this Code requires or permits other overcurrent protection ratings.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo**)**

Tentative Interim Amendment

NFPA® 70®

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2023 Edition

Reference: Table C.18, Table C.19 and Table C.20
TIA 23-7
(SC 22-12-7 / TIA Log #1678)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 8, and the NEC Correlating Committee, and was issued by the Standards Council on December 8, 2022, with an effective date of December 28, 2022.

*1. Revise Table Headers **only** for Table C.18, Table, C.19 and Table C.20 to read as follows:*

Table C.18 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.19 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.20 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Issue Date: December 8, 2022

Effective Date: December 28, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

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2023 Edition

Reference: 555.35
TIA 23-6
(SC 22-8-23 / TIA Log #1660)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.35 to read as follows:

555.35 Ground-Fault Protection of Equipment (GFPE) and Ground-Fault Circuit Interrupter. For other than floating buildings, ground-fault protection for docking facilities shall be provided in accordance with 555.35(A) through (~~F~~D).

~~**(A) Sources Directly Supplying Docking Facilities or Wharfs.** Listed GFPE, rated not more than 100 milliamperes, shall be provided for sources directly supplying all docking facilities or wharfs. Coordination with downstream GFPE shall be permitted.~~

(~~B~~A) Feeder. …

Exception: Transformer secondary conductors of a separately derived system that do not exceed 3 m (10 ft) and are installed in a raceway shall be permitted to be installed without ground-fault protection. This exception shall also apply to the supply terminals of the equipment supplied by the transformer secondary conductors.

(~~C~~B) Branch-Circuits.

(1) Receptacles Providing Shore Power. …

(2) Outlets for Other than Shore Power. Outlets supplied by branch circuits not exceeding 150 volts to ground and 60 amperes, single phase, and 150 volts or less to ground, 100 amperes or less, three phase, shall be provided with GFCI protection for personnel.

Exception to (~~C~~B): Low-voltage circuits not requiring grounding, not exceeding the low-voltage contact limit and supplied by listed transformers or power supplies that comply with 680.23(A)(2) shall be permitted to be installed without ground-fault protection.

(~~D~~C) Boat Hoists. …

(~~E~~D) Leakage Current Measurement Device. …

Informational Note No. 1: …

Informational Note No. 2: …

Exception: Where the shore power equipment includes a leakage indicator and leakage alarm, a separate leakage test device shall not be required.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 555.30
TIA 23-5
(SC 22-8-22 / TIA Log #1659)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.30 to read as follows:

555.30 Electrical Equipment and Connections.

(A) General. All electrical components within electrical equipment (excluding wiring methods) and connections not intended for operation while submerged shall be located at least 305 mm (12 in.) above the deck of a fixed or floating structure, but not below the electrical datum plane. Conductor splices, within junction boxes identified for wet locations, utilizing sealed wire connector systems listed and identified for submersion shall be required for floating structures where located above the waterline but below the electrical datum plane.

(B) Replacements. …

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 215.15
TIA 23-4
(SC 22-8-18 / TIA Log #1655)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 215.15 to read as follows:

215.15 Barriers. Barriers shall be placed such that no energized, uninsulated, ungrounded busbar or terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations in panelboards, switchboards, switchgear, or motor control centers supplied by feeder taps in 240.21(B) or transformer secondary conductors in 240.21(C) when the disconnecting device, to which the tap conductors are terminated, is in the open position.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 210.8(F) and Exception No. 2(new)
TIA 23-3
(SC 22-8-17 / TIA Log #1654)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 210.8(F) to read as follows:

210.8(F) Outdoor Outlets.
For dwellings, all outdoor outlets, other than those covered in 210.8(A), Exception No. 1, including outlets installed in the following locations, and supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, shall be provided with GFCI protection:

(1) Garages that have floors located at or below grade level
(2) Accessory buildings
(3) Boathouses

If equipment supplied by an outlet covered under the requirements of this section is replaced, the outlet shall be supplied with GFCI protection.

Exception No. 1: GFCI protection shall not be required on lighting outlets other than those covered in 210.8(C).
Exception No. 2: GFCI protection shall not be required for listed HVAC equipment. This exception shall expire September 1, 2026.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Article 100 (Ignitible Fibers/Flyings), 506.5, and 506.9(B)
TIA 23-2
(SC 22-4-8 / TIA Log #1617)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise Article 100 Ignitible Fibers/Flyings to read as follows:

Ignitible Fibers/Flyings. Fibers/flyings where any dimension is greater than 500 μm in nominal size, which are not likely to be in suspension in quantities to produce an explosible mixture, but could produce an ignitible layer fire hazard. [**499:**3.3.4.2]

Informational Note No.1: This definition and Informational Note No. 2 have been extracted from NFPA 499-2021, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.* The NFPA 499 reference is in brackets. Only editorial changes were made to the extracted text to make it consistent with this *Code.*

Informational Note No. 2: Section 500.5 of this *Code* prescribes a Class III location as one where ignitible fibers/flyings are present, but not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. This description addresses fibers/flyings that do not present a flash-fire hazard or explosion hazard by test. This could be because those fibers/flyings are too large or too agglomerated to be suspended in air in sufficient concentration, or at all, under typical test conditions. Alternatively, this could be because they burn so slowly that, when suspended in air, they do not propagate combustion at any concentration. In this document the zone classification system includes ignitible fibers/flyings as a fire hazard in a layer, which is not addressed in the IEC zone system (see IEC 60079-10-2, *Explosive atmospheres — Part 10-2: Classification of areas — Explosive dust atmospheres*). Where these are present, the user could also consider installation in accordance with Article 503 of this *Code.* [**499:**A.3.3.4.2]

2. Revise Section 506.5 to read as follows:

506.5 Classification of Locations.
(A) Classifications of Locations. …
(B) Zone 20, Zone 21, and Zone 22 Locations. …
(1) Zone 20. A Zone 20 location is a location where one of the following apply:
(1) Ignitible concentrations of combustible dust, ~~or~~ combustible fibers/flyings, or ignitible fibers/flyings are present continuously or for long periods of time.
…
(2) Zone 21. …
(3) Zone 22. A Zone 22 location is a location where one of the following apply:
(1) …
(2) Combustible dust, combustible fibers/flyings, or ignitible fibers/flyings are handled, processed, or used…
(3) …

3. Revise Section 506.9(B) to read as follows:

506.9 Equipment Requirements.
…

(B) Listing. Equipment that is listed for Zone 20 shall be permitted in a Zone 21 or Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying. Equipment that is listed for Zone 21 ~~can be used~~ shall be permitted in a Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying.

Issue Date: April 12, 2022

Effective Date: May 2, 2022

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 680.43, Exception No. 3
TIA 23-16
(SC 24-12-6 / TIA Log #1800)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17, and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on December 4, 2024, with an effective date of December 24, 2024.

1. Delete Exception No. 3 of 680.43 as follows:

680.43 Indoor Installations. A spa or hot tub installed indoors shall comply with the provisions of Parts I and II of this article except as modified by this section and shall be connected by the wiring methods of Chapter 3.

Exception No. 1: Listed spa and hot tub …

Exception No. 2: The equipotential bonding …

~~*Exception No. 3: For a dwelling unit(s) only, where a listed spa or hot tub is installed indoors, the wiring method requirements of 680.42(C) shall also apply.*~~

Issue Date: December 4, 2024

Effective Date: December 24, 2024

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 210.70
TIA 23-15
(SC 23-11-10/ TIA Log #1753)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 2, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 210.70 to read as follows:

210.70 Lighting Outlets Required. Lighting outlets shall be installed where specified in 210.70(A), (B), and (C). The switch or listed wall-mounted control device shall not rely exclusively on ~~a~~ battery power unless ~~a~~ it incorporates a positive means of notification of impending battery depletion. ~~is provided for automatically energizing the lighting outlets upon battery failure.~~

Issue Date: November 30, 2023

Effective Date: December 20, 2023

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 517.30(B)(3)(a)
TIA 23-14
(SC 23-11-9 / TIA Log #1752)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 15, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 517.30(B)(3)(a) to read as follows:

517.30(B)(3) Fuel Cell Systems. Fuel cell systems shall be permitted to serve as the alternate power source for all or part of an EES. [**99:**6.7.1.5.1]

(a) Installation of fuel cells shall comply with the requirements in Parts I through VI ~~VII~~ of Article 692 ~~for 1000 volts or less and Part VIII for over 1000 volts~~.

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 400.47
TIA 23-13
(SC 23-8-57 / TIA Log #1731)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by Code-Making Panel 6 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise section 400.47 to read as follows:

400.47. ~~Minimum~~ Conductor Bending ~~Radii~~ Radius. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 2000 volts to 5000 volts shall not ~~exceed~~ be bent to a radius less than six times the overall cable outer diameter. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 5001 volts to 25,000 volts shall not ~~exceed~~ be bent to a radius less than eight-times the overall cable outer diameter.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 408.6
TIA 23-12
(SC 23-8-56 / TIA Log #1699)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by Code-Making Panel 9 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 408.6 to read as follows:

408.6 Short-Circuit Current Rating. Switchboards, switchgear, and panelboards shall have a short-circuit current rating not less than the available fault current. In other than one- and two-family dwelling units, the available fault current and the date the calculation was performed shall be field marked on the enclosure at the point of supply. The marking shall <u>be of sufficient durability to withstand the environment involved.</u> ~~comply with 110.21(B)(3).~~

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 700.32(C), 701.32(C), and 708.54(C)
TIA 23-11
(SC 23-8-54 / TIA Log #1692)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by Code-Making Panel 13 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 700.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

700.32 Selective Coordination.

700.32(A) General. Emergency system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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

700.32(B) Replacements. Where emergency system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

700.32(C) Modifications. If modifications, additions, or deletions to the emergency system(s) occur, selective coordination of the emergency system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 700.32~~(C)~~ for an example of how emergency system OCPDs selectively coordinate with all supply-side OCPDs.

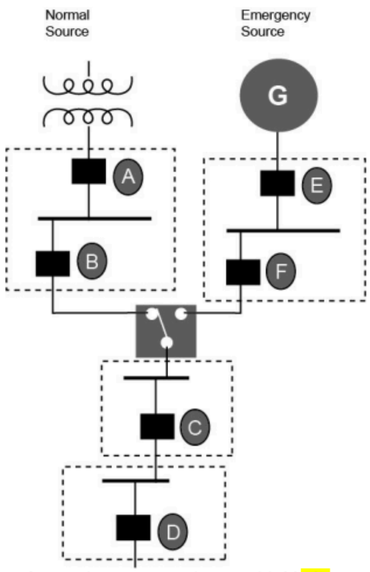
~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~

~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~

~~OCPD F selectively coordinates with OCPD E.~~

~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.~~

EN12024Text Modification



Informational Note Figure 700.32~~(C)~~ Emergency System Selective Coordination.

OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.

2. Revise 701.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

701.32 Selective Coordination.

701.32(A) General. Legally required standby system(s) overcurrent protective devices (OCPDs shall be selectively coordinated with all supply-side and load-side OCPDs.

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

701.32(B) Replacements. Where legally required standby OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

701.32(C) Modifications. If modifications, additions, or deletions to the legally required standby system(s) occur, selective coordination of the legally required system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 701.32~~(C)~~ for an example of how legally required standby system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.~~

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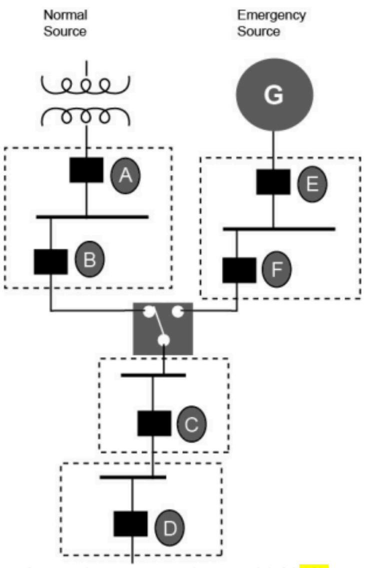


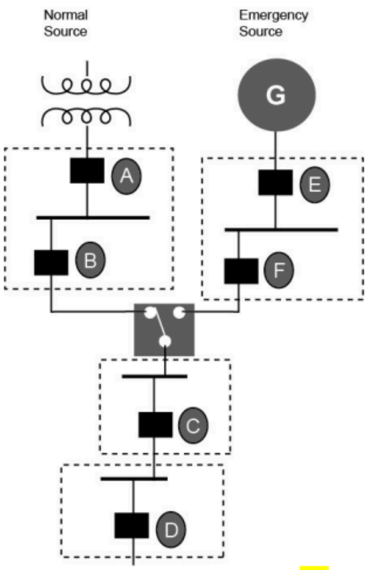
Informational Note Figure 701.32~~(C)~~ Legally Required Standby System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.

3. Revise 708.54(C) Informational Note and title of Figure for the Informational Note to read as follows:

708.54(A) General. Critical operations power system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.
Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.
708.54(B) Replacements. Where critical operations power system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.
708.54(C) Modifications. If modifications, additions, or deletions to the critical operations power system(s) occur, selective coordination of the critical operations power system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.
Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.

Informational Note: See Informational Note Figure 708.54~~(C)~~ for an example of how critical operations power system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.~~



Informational Note Figure 708.54~~(C)~~ Critical Operations Power System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 314.29(A)
TIA 23-10
(SC 23-3-10 / TIA Log #1690)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 9 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 314.29(A) to read as follows:

314.29 Boxes, Conduit Bodies, and Handhole Enclosures to Be Accessible. Boxes, conduit bodies, and handhole enclosures shall be installed so that wiring and devices contained in the boxes, conduit bodies, or handhole enclosures can be rendered accessible in accordance with 314.29(A) and (B).

(A) In Buildings and Other Structures. Boxes and conduit bodies shall be installed so the contained wiring and devices are accessible. Boxes and conduit bodies that are recessed into or behind finished surfaces of buildings shall have access to their internal contents maintained by openings in their covers and in the building finish that comply with 314.29(A)(1), (A)(2), or (A)(3) as applicable. Removable finished covers and faceplates that maintain this access shall be permitted.

(1) Boxes 1650 cm³ (100 in.³) or Less in Size. The openings in the building surfaces, if reduced from the outer walls of the box, shall be centered not more than 25 mm (1 in.) from the centerline of the box, and shall not extend beyond the walls of the box. If rectangular, the opening shall be not less than 73 mm (2 7/8 in.) by 45 mm (1 3/4 in.) in size. If circular, the opening shall not be less than 90 mm (3½ in.) in diameter.

Exception: Smaller openings in building surfaces that accommodate one or more individual devices shall be permitted if all of the following conditions are met:

(1) The outlet box that supplies the device(s) is nonmetallic.
(2) The branch circuit wiring that supplies each device consists of a separate nonmetallic cable assembly originating outside the box, or individual sets of conductors in a single nonmetallic raceway, all of which originate outside the box. Other than the connections to a single device, these conductors are not spliced in the box or continued to another device, and no other wiring or raceways enter the box.
(3) Each device is capable of removal from the building surface opening without being damaged. If a special tool is required for this purpose, the applicable circuit directory for the device records the location of the tool, together with a product code/QR code for acquiring a replacement if necessary.
(4) All connections for each device to the branch circuit wiring are made with listed clamping-type wire connectors, which are supplied with the devices. The branch-circuit conductors are arranged to permit the connector(s) to be exposed after the device has been fully removed.
(5) The device assemblies are listed for this application.

(2) Boxes Larger Than 1650 cm³ (100 in.³) in Size. The openings shall not be smaller than the outer walls of the box.
(3) Conduit Bodies. The openings shall not be smaller than outer walls of the conduit body.
(B) Underground. Underground boxes and handhole enclosures shall be installed …

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 250.114(3)e and 250.114(4)e
TIA 23-1
(SC 21-12-13 / TIA Log #1608)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise 250.114(3)e and (4)e to read as follows:

250.114 Equipment Connected by Cord and Plug. Exposed, normally non-current-carrying metal parts of cord-and-plug-connected equipment shall be connected to the equipment grounding conductor under any of the following conditions:

…

(3) In residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

(4) In other than residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

…

Issue Date: December 8, 2021

Effective Date: December 28, 2021

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Energy Conservation

EN12025

14

Date Submitted	02/11/2025	**Section**	106.1	**Proponent**	Bryan Holland
Chapter	6	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

A related modification has been submitted to the FBC-B and FBC-R to update the reference to NFPA 70-23, including all published TIAs.

Summary of Modification

This proposed modification recommends adoption of NFPA 70-23, including all published Tentative Interim Amendments (TIAs)

Rationale

This proposed modification recommends updating the adopted edition of NFPA 70 to the 2023 edition, including all published TIAs (TIA 23-1 through TIA 23-16). Tentative Interim Amendments (TIAs) are important revisions to the code that have been issued by the NFPA Standards Council after publication of the document. All issued TIAs have been reviewed and approved through consensus voting on the basis of "technical merit" and "emergency nature" by the corresponding Code Making Panel, without creating a correlation issue with any other sections of the code. For the 2023 edition of NFPA 70, TIAs 23-1 through 23-6 were issued prior to publication of the code and incorporated into the first printing. This proposed modification recommends all TIAs, 23-1 through 23-16 be officially adopted and incorporated into the code. This will help reduce conflicts in the field and improve consistent enforcement across all Florida jurisdictions.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

This proposed modification will improve the consistent enforcement of the code by the local entity.

Impact to building and property owners relative to cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Impact to industry relative to the cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Impact to small business relative to the cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The changes made to the 2023 NEC along with all issued TIAs represent important improvements and corrections to the published code. All (16) TIAs have been deemed to have both technical merit and emergency in nature, thus increasing the health, safety, and welfare of the general public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification improves the code by updating to the most current edition of the NEC and by incorporating corrections made after initial publication.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

This proposed modification improves the effectiveness of the code.

EN12025Text Modification

Chapter 6 [RE] Referenced Standards

NFPA

70 - ~~20~~ 23 National Electrical Code (NEC), including all published Tentative Interim Amendments (TIAs) published until December 4, 2024

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Mod12025_TextOfModification.pdf

EN12025Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Definition of Pool, and 680.26
TIA 23-9
(SC 23-3-8 / TIA Log #1687)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise the definition of "Pool" to read as follows:

Pool. Manufactured or field-constructed equipment designed to contain water on a permanent or semipermanent basis and used by persons for swimming, wading, immersion, or therapeutic purposes, but not including bodies of water incorporated as part of an industrial process or lakes, lagoons, surf parks, or other natural and man-made bodies of water that may incorporate swimming and swimming areas. (680) (CMP-17)

Informational Note: Natural and man-made bodies of water, which includes lakes, lagoons, surf parks, or other similar bodies of water, are addressed in Article 682.

2. Revise section paragraph 680.26 to read as follows:

680.26 Equipotential Bonding.

(A) Performance. The equipotential bonding required by 680.26(B) and (C) to reduce voltage gradients in the pool area shall be installed for pools with or without associated electrical equipment related to the pool.

Informational Note No. 1: Some causes of voltage gradients originate outside the premises wiring system and are not within the scope of the *NEC*. Measures identified in Rule 097D2 of ANSI C2, *National Electrical Safety Code*, can also serve to address voltage gradients originating on the utility side of the service point.

Informational Note No. 2: By its nature, equipotential bonding of swimming pools and perimeter surfaces involves contact between various metallic materials and the earth. This can, in some cases, expose various specific metals to a corrosive environment, depending on factors such as the type and chemical content of the soil and the specific metal. Corrosive environments are also addressed in 680.14.

(B) Bonded Parts. …

(1) Conductive Pool Shells. …

(2) Perimeter Surfaces. The perimeter surface to be bonded shall be considered to extend for ~~1 m~~ 900 mm (3 ft) horizontally beyond the inside walls of the pool ~~and~~ while also at a height between 900 mm (3 ft) above and 600 mm (2 ft) below the maximum water level. The perimeter surface shall include unpaved surfaces, concrete, and other types of paving. Perimeter surfaces separated from the pool by a permanent wall or building 1.5 m (5 ft) in height or more shall

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require equipotential bonding only on the pool side of the permanent wall or building. Bonding to perimeter surfaces shall be provided as specified in 680.26(B)(2)(a), (B)(2)(b), ~~or~~ (B)(2)(c), and (B)(2)(d). ~~and~~ For conductive pool shells where bonding to perimeter surfaces is required, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four points uniformly spaced around the perimeter of the pool, or if the bonded perimeter surface does not surround the entire pool, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four uniformly spaced points along the bonded perimeter surface. For nonconductive pool shells where bonding to the perimeter surfaces is required, bonding at four points shall not be required, and the perimeter bonding shall be attached to the 8 AWG copper equipotential bonding conductor and, if present, to any conductive support structure for the pool.

Informational Note: Because the perimeter surface can incorporate various types of materials at various locations and elevations above and below maximum water level, the perimeter surface required to be bonded might not surround the entire pool. The 8 AWG copper equipotential bonding conductor can encircle the entire pool to facilitate connection of bonded parts.

(a) ~~*Structural Reinforcing Steel.* Structural reinforcing steel shall be bonded in accordance with 680.26(B)(1)(a).~~ *Conductive Paved Portions of Perimeter Surfaces.* Conductive paved portions of perimeter surfaces, including masonry pavers, if used, shall be bonded with unencapsulated structural reinforcing steel in accordance with 680.26(B)(1)(a), or with unencapsulated steel structural welded wire reinforcement (welded wire mesh, welded wire fabric), bonded together by steel tie wires or the equivalent. Steel welded wire reinforcement shall be fully embedded within the pavement unless the pavement will not allow for embedding. If the reinforcing steel is absent, or is encapsulated in a nonconductive compound, or embedding is not possible, unencapsulated welded wire steel reinforcement or a copper conductor grid shall be provided and shall be secured directly under the paving, and not more than 150 mm (6 in.) below finished grade.

Unencapsulated steel welded wire reinforcement that is not fully embedded in concrete, and copper grid regardless of location, where used for equipotential bonding, shall be listed for corrosion resistance and mechanical performance. This listing requirement shall become effective January 1, 2025. The copper grid or unencapsulated steel welded wire reinforcement shall also meet the following:

(1) Copper grid is constructed of 8 AWG solid bare copper and arranged in accordance with 680.26(B)(1)(b)(3).
(2) Steel welded wire reinforcement is minimum ASTM 6x6-W2.0 x W2.0 or minimum No. 3 rebar constructed in a 300 mm (12 in.) grid.
(3) Copper grid and steel welded wire reinforcement follow the contour of the perimeter surface extending not less than 900 mm (3 ft) horizontally beyond the inside walls of the pool.
(4) Only listed splicing devices or exothermic welding are used.

Informational Note No. 1: Performance of the equipotential bonding system at the perimeter surface is improved as the distance between the bonding means and finished grade is minimized, either by embedding within, or by direct contact with the underside of, the finished pavement.

Informational Note No. 2: See ASTM A615/A615M, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement;* A1064/A1064M, *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete;* A1022/A1022M, *Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement;* A1060A/A1060M, *Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete;* and ACI Standard ACI 318, *Building Code Requirements for Structural Concrete,* for examples of standards currently used in the listing of reinforcing steel bars and steel welded wire reinforcement.

(b) *Unpaved Portions of Perimeter Surfaces.* Unpaved portions of perimeter surfaces shall be bonded with any of the following methods:
(1) ~~*Copper Ring.* Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, a c~~Copper conductor(s) shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. At least one minimum 8 AWG bare solid copper conductor, including the 8 AWG copper equipotential bonding conductor if available ~~shall be provided~~.
~~(2)~~b. The conductors ~~shall~~ follow the contour of the perimeter surface.
~~(3)~~c. Only listed splicing devices or exothermic welding are used. ~~shall be permitted.~~
~~(4)~~d. The ~~required~~ conductor(s) is ~~shall be~~ 450 mm to 600 mm (18 in. to 24 in.) from the inside walls of the pool.
~~(5)~~e. The ~~required~~ conductor(s) ~~shall be secured within or~~ is under the unpaved portion of the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.
f. Be installed only in perimeter surfaces not intended to have direct access to swimmers in the pool.

(~~c~~2) ~~*Copper Grid*. Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, c~~Copper grid or unencapsulated steel welded wire reinforcement used for equipotential bonding of unpaved portions of perimeter surfaces shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. ~~The copper grid shall be constructed of 8 AG solid bare copper and be arranged~~ Be installed in accordance with 680.26~~(B)(1)(b)(3)~~(B)(2)(a).
~~(2) The copper grid shall follow the contour of the perimeter surface extending 1 m (3 ft) horizontally beyond the inside walls of the pool.~~
~~(3) Only listed splicing devices or exothermic welding shall be permitted.~~
~~(4)~~b. ~~The copper grid shall be secured~~ Be located within ~~or under~~ the ~~deck or~~ unpaved surface(s) between 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.

(c) *Nonconductive Perimeter Surfaces.* Equipotential bonding shall not be required for nonconductive portions of perimeter surfaces that are separated from earth or raised on nonconducting supports, and it shall not be required for any perimeter surface that is electrically separated from the pool structure and raised on nonconductive supports above an equipotentially bonded surface.

> Informational Note: Nonconductive materials include, but are not limited to, wood, plastic, wood-plastic composites, fiberglass, and fiberglass composites.

(d) *Interconnection of Bonded Portions of Perimeter Surfaces.* All surfaces where equipotential bonding is required shall be interconnected using listed splicing devices or exothermic welding. Where copper wire is used for this purpose, it shall be solid copper, not smaller than 8 AWG. The conductor shall be permitted to encircle the pool to facilitate bonding connections to portions of the perimeter covered in 680.26(B)(2)(a) and (B)(2)(b) that are not contiguous.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

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2023 Edition

Reference: 300.26
TIA 23-8
(SC 23-3-9 / TIA Log #1688)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by the NEC Code-Making Panel 3 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 300.26 to read as follows:

300.26 Remote-Control and Signaling Circuits Classification.
Remote-control and signaling circuits shall be classified as either power-limited or non-power-limited and comply with ~~the following~~300.26(A) through (C).

(~~1~~A) **Class 1 Power-Limited Remote-Control and Signaling Circuits**. Class 1 power-limited remote-control and signaling circuits shall comply with 724.3.

(~~2~~B) **Class 2 and Class 3 Power-Limited Remote-Control and Signaling Circuits**. Class 2 and Class 3 power-limited remote-control and signaling circuits shall comply with 725.3.

(~~3~~C) **Non-Power-Limited Remote-Control and Signaling Circuits**. Non-power-limited remote-control and signaling circuits shall be installed in accordance with 300.2 through 300.25 and comply with 300.26(C)(1) through (C)(3).

(1) Sizes and Use.

(a) Conductors that are 18 AWG and 16 AWG copper shall be permitted to be used if they supply loads that do not exceed the ampacities specified in 402.5 and are installed in a raceway, an approved enclosure, or a listed cable.

(b) Conductors that are 14 AWG copper-clad aluminum shall be permitted to be used in Type MC cable and Type TC cable. The continuous load shall not exceed 8 amperes.

(c) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall not supply loads greater than the ampacities specified in 310.14.

(d) Flexible cords shall comply with the applicable general requirements, applications, and construction specifications for flexible cords and flexible cables in accordance with Article 400 Parts I and II.

(2) Insulation.

(a) Insulation on conductors shall be rated for the system voltage and not less than 600 volts.

(b) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall comply with the applicable general requirements for conductors rated up to and including 2000 volt for type designations, insulations, markings, ampacity ratings, and uses in accordance with 310.3, 310.4, 310.6, 310.8, 310.10, and 310.14.

(c) Conductors that are 18 AWG copper, 16 AWG copper, or 14 AWG copper-clad aluminum shall be Type FFH-2, Type KF-2, Type KFF-2, Type PAF, Type PAFF, Type PF, Type PFF, Type PGF, Type PGFF, Type PTF, Type PTFF, Type RFH-2, Type RFHH-2, Type RFHH-3, Type SF-2, SFF-2, Type TF, Type TFF, Type TFFN, Type TFN, Type ZF, or Type ZFF.

(d) Conductors with other types and thicknesses of insulation shall be permitted if listed for Class 1 circuit use.

(3) Overcurrent Protection.

(a) Overcurrent protection for conductors 14 AWG copper and larger shall be provided in accordance with the conductor ampacity, without applying the ampacity adjustment and correction factors specified in 310.15 to the ampacity calculation.

(b) Overcurrent protection shall not exceed 7 amperes for 18 AWG copper conductors and 10 amperes for 16 AWG copper and 14 AWG copper-clad aluminum.

Exception: The overcurrent protection specified in 300.26(C)(3)(1) and 300.26(C)(3)(2) shall not be required where this Code requires or permits other overcurrent protection ratings.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo**)**

Tentative Interim Amendment

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Reference: Table C.18, Table C.19 and Table C.20
TIA 23-7
(SC 22-12-7 / TIA Log #1678)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 8, and the NEC Correlating Committee, and was issued by the Standards Council on December 8, 2022, with an effective date of December 28, 2022.

*1. Revise Table Headers **only** for Table C.18, Table, C.19 and Table C.20 to read as follows:*

Table C.18 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.19 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.20 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Issue Date: December 8, 2022

Effective Date: December 28, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Tentative Interim Amendment

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Reference: 555.35
TIA 23-6
(SC 22-8-23 / TIA Log #1660)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.35 to read as follows:

555.35 Ground-Fault Protection of Equipment (GFPE) and Ground-Fault Circuit Interrupter. For other than floating buildings, ground-fault protection for docking facilities shall be provided in accordance with 555.35(A) through (~~F~~D).

~~**(A) Sources Directly Supplying Docking Facilities or Wharfs.** Listed GFPE, rated not more than 100 milliamperes, shall be provided for sources directly supplying all docking facilities or wharfs. Coordination with downstream GFPE shall be permitted.~~

(~~B~~A) Feeder. …

Exception: Transformer secondary conductors of a separately derived system that do not exceed 3 m (10 ft) and are installed in a raceway shall be permitted to be installed without ground-fault protection. This exception shall also apply to the supply terminals of the equipment supplied by the transformer secondary conductors.

(~~C~~B) Branch-Circuits.

(1) Receptacles Providing Shore Power. …

(2) Outlets for Other than Shore Power. Outlets supplied by branch circuits not exceeding 150 volts to ground and 60 amperes, single phase, and 150 volts or less to ground, 100 amperes or less, three phase, shall be provided with GFCI protection for personnel.

Exception to (~~C~~B): Low-voltage circuits not requiring grounding, not exceeding the low-voltage contact limit and supplied by listed transformers or power supplies that comply with 680.23(A)(2) shall be permitted to be installed without ground-fault protection.

(~~D~~C) Boat Hoists. …

(~~E~~D) Leakage Current Measurement Device. …

Informational Note No. 1: …

Informational Note No. 2: …

Exception: Where the shore power equipment includes a leakage indicator and leakage alarm, a separate leakage test device shall not be required.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Tentative Interim Amendment

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Reference: 555.30
TIA 23-5
(SC 22-8-22 / TIA Log #1659)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.30 to read as follows:

555.30 Electrical Equipment and Connections.

(A) General. All electrical components within electrical equipment (excluding wiring methods) and connections not intended for operation while submerged shall be located at least 305 mm (12 in.) above the deck of a fixed or floating structure, but not below the electrical datum plane. Conductor splices, within junction boxes identified for wet locations, utilizing sealed wire connector systems listed and identified for submersion shall be required for floating structures where located above the waterline but below the electrical datum plane.

(B) Replacements. …

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

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Reference: 215.15
TIA 23-4
(SC 22-8-18 / TIA Log #1655)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 215.15 to read as follows:

215.15 Barriers. Barriers shall be placed such that no energized, uninsulated, ungrounded busbar or terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations in panelboards, switchboards, switchgear, or motor control centers supplied by feeder taps in 240.21(B) or transformer secondary conductors in 240.21(C) when the disconnecting device, to which the tap conductors are terminated, is in the open position.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 210.8(F) and Exception No. 2(new)
TIA 23-3
(SC 22-8-17 / TIA Log #1654)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 210.8(F) to read as follows:

210.8(F) Outdoor Outlets.
For dwellings, all outdoor outlets, other than those covered in 210.8(A), Exception No. 1, including outlets installed in the following locations, and supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, shall be provided with GFCI protection:

(1) Garages that have floors located at or below grade level
(2) Accessory buildings
(3) Boathouses

If equipment supplied by an outlet covered under the requirements of this section is replaced, the outlet shall be supplied with GFCI protection.
Exception No. 1: GFCI protection shall not be required on lighting outlets other than those covered in 210.8(C).
Exception No. 2: GFCI protection shall not be required for listed HVAC equipment. This exception shall expire September 1, 2026.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

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Reference: Article 100 (Ignitible Fibers/Flyings), 506.5, and 506.9(B)
TIA 23-2
(SC 22-4-8 / TIA Log #1617)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise Article 100 Ignitible Fibers/Flyings to read as follows:

Ignitible Fibers/Flyings. Fibers/flyings where any dimension is greater than 500 µm in nominal size, which are not likely to be in suspension in quantities to produce an explosible mixture, but could produce an ignitible layer fire hazard. [**499:**3.3.4.2]

Informational Note No.1: This definition and Informational Note No. 2 have been extracted from NFPA 499-2021, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.* The NFPA 499 reference is in brackets. Only editorial changes were made to the extracted text to make it consistent with this *Code.*

Informational Note No. 2: Section 500.5 of this *Code* prescribes a Class III location as one where ignitible fibers/flyings are present, but not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. This description addresses fibers/flyings that do not present a flash-fire hazard or explosion hazard by test. This could be because those fibers/flyings are too large or too agglomerated to be suspended in air in sufficient concentration, or at all, under typical test conditions. Alternatively, this could be because they burn so slowly that, when suspended in air, they do not propagate combustion at any concentration. In this document the zone classification system includes ignitible fibers/flyings as a fire hazard in a layer, which is not addressed in the IEC zone system (see IEC 60079-10-2, *Explosive atmospheres — Part 10-2: Classification of areas — Explosive dust atmospheres*). Where these are present, the user could also consider installation in accordance with Article 503 of this *Code.* [**499:**A.3.3.4.2]

2. Revise Section 506.5 to read as follows:

506.5 Classification of Locations.
(A) Classifications of Locations. …
(B) Zone 20, Zone 21, and Zone 22 Locations. …
(1) Zone 20. A Zone 20 location is a location where one of the following apply:
(1) Ignitible concentrations of combustible dust, ~~or~~ combustible fibers/flyings, or ignitible fibers/flyings are present continuously or for long periods of time.
…
(2) Zone 21. …
(3) Zone 22. A Zone 22 location is a location where one of the following apply:
(1) …
(2) Combustible dust, combustible fibers/flyings, or ignitible fibers/flyings are handled, processed, or used…
(3) …

3. Revise Section 506.9(B) to read as follows:

506.9 Equipment Requirements.
…

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(B) Listing. Equipment that is listed for Zone 20 shall be permitted in a Zone 21 or Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying. Equipment that is listed for Zone 21 ~~can be used~~ shall be permitted in a Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying.

Issue Date: April 12, 2022

Effective Date: May 2, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo**)**

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Reference: 680.43, Exception No. 3
TIA 23-16
(SC 24-12-6 / TIA Log #1800)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17, and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on December 4, 2024, with an effective date of December 24, 2024.

1. Delete Exception No. 3 of 680.43 as follows:

680.43 Indoor Installations. A spa or hot tub installed indoors shall comply with the provisions of Parts I and II of this article except as modified by this section and shall be connected by the wiring methods of Chapter 3.

Exception No. 1: Listed spa and hot tub …

Exception No. 2: The equipotential bonding …

~~*Exception No. 3: For a dwelling unit(s) only, where a listed spa or hot tub is installed indoors, the wiring method requirements of 680.42(C) shall also apply.*~~

Issue Date: December 4, 2024

Effective Date: December 24, 2024

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Tentative Interim Amendment

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Reference: 210.70
TIA 23-15
(SC 23-11-10/ TIA Log #1753)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by the NEC Code-Making Panel 2, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 210.70 to read as follows:

210.70 Lighting Outlets Required. Lighting outlets shall be installed where specified in 210.70(A), (B), and (C). The switch or listed wall-mounted control device shall not rely exclusively on ~~a~~ battery power unless ~~a~~ it incorporates a positive means of notification of impending battery depletion. ~~is provided for automatically energizing the lighting outlets upon battery failure.~~

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 517.30(B)(3)(a)
TIA 23-14
(SC 23-11-9 / TIA Log #1752)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 15, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 517.30(B)(3)(a) to read as follows:

517.30(B)(3) Fuel Cell Systems. Fuel cell systems shall be permitted to serve as the alternate power source for all or part of an EES. [**99:**6.7.1.5.1]

(a) Installation of fuel cells shall comply with the requirements in Parts I through VI ~~VII~~ of Article 692~~ for 1000 volts or less and Part VIII for over 1000 volts~~.

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

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Reference: 400.47
TIA 23-13
(SC 23-8-57 / TIA Log #1731)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by Code-Making Panel 6 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise section 400.47 to read as follows:

400.47. ~~Minimum~~ Conductor Bending ~~Radii~~ Radius. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 2000 volts to 5000 volts shall not ~~exceed~~ be bent to a radius less than six times the overall cable outer diameter. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 5001 volts to 25,000 volts shall not ~~exceed~~ be bent to a radius less than eight-times the overall cable outer diameter.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

EN12025Text Modification

Tentative Interim Amendment

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Reference: 408.6
TIA 23-12
(SC 23-8-56 / TIA Log #1699)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by Code-Making Panel 9 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 408.6 to read as follows:

408.6 Short-Circuit Current Rating. Switchboards, switchgear, and panelboards shall have a short-circuit current rating not less than the available fault current. In other than one- and two-family dwelling units, the available fault current and the date the calculation was performed shall be field marked on the enclosure at the point of supply. The marking shall be of sufficient durability to withstand the environment involved. ~~comply with 110.21(B)(3).~~

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 700.32(C), 701.32(C), and 708.54(C)
TIA 23-11
(SC 23-8-54 / TIA Log #1692)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by Code-Making Panel 13 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 700.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

700.32 Selective Coordination.

700.32(A) General. Emergency system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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

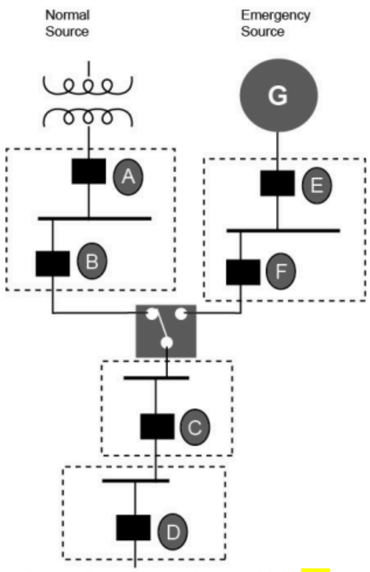
700.32(B) Replacements. Where emergency system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

700.32(C) Modifications. If modifications, additions, or deletions to the emergency system(s) occur, selective coordination of the emergency system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 700.32~~(C)~~ for an example of how emergency system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.~~



Informational Note Figure 700.32~~(C)~~ Emergency System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.

2. Revise 701.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

701.32 Selective Coordination.

701.32(A) General. Legally required standby system(s) overcurrent protective devices (OCPDs shall be selectively coordinated with all supply-side and load-side OCPDs.

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

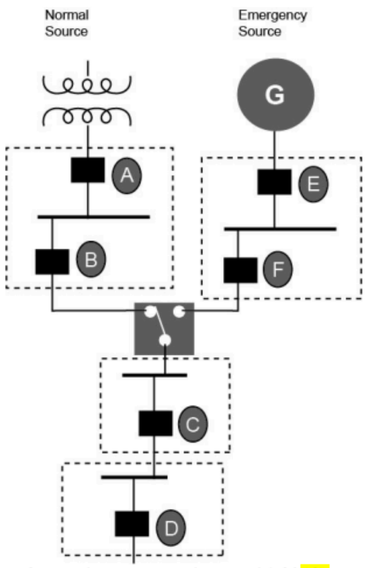
701.32(B) Replacements. Where legally required standby OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

701.32(C) Modifications. If modifications, additions, or deletions to the legally required standby system(s) occur, selective coordination of the legally required system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 701.32~~(C)~~ for an example of how legally required standby system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.~~



Informational Note Figure 701.32~~(C)~~ Legally Required Standby System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.

3. *Revise 708.54(C) Informational Note and title of Figure for the Informational Note to read as follows:*

708.54(A) General. Critical operations power system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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

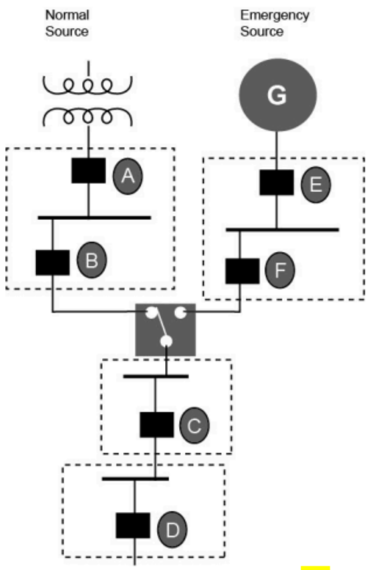
708.54(B) Replacements. Where critical operations power system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

708.54(C) Modifications. If modifications, additions, or deletions to the critical operations power system(s) occur, selective coordination of the critical operations power system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 708.54~~(C)~~ for an example of how critical operations power system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.~~



Informational Note Figure 708.54~~(C)~~ Critical Operations Power System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 314.29(A)
TIA 23-10
(SC 23-3-10 / TIA Log #1690)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 9 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 314.29(A) to read as follows:

314.29 Boxes, Conduit Bodies, and Handhole Enclosures to Be Accessible. Boxes, conduit bodies, and handhole enclosures shall be installed so that wiring and devices contained in the boxes, conduit bodies, or handhole enclosures can be rendered accessible in accordance with 314.29(A) and (B).

(A) In Buildings and Other Structures. Boxes and conduit bodies shall be installed so the contained wiring and devices are accessible. Boxes and conduit bodies that are recessed into or behind finished surfaces of buildings shall have access to their internal contents maintained by openings in their covers and in the building finish that comply with 314.29(A)(1), (A)(2), or (A)(3) as applicable. Removable finished covers and faceplates that maintain this access shall be permitted.

(1) Boxes 1650 cm^3 (100 in.^{3}) or Less in Size. The openings in the building surfaces, if reduced from the outer walls of the box, shall be centered not more than 25 mm (1 in.) from the centerline of the box, and shall not extend beyond the walls of the box. If rectangular, the opening shall be not less than 73 mm (2 7/8 in.) by 45 mm (1 3/4 in.) in size. If circular, the opening shall not be less than 90 mm (3½ in.) in diameter.

Exception: Smaller openings in building surfaces that accommodate one or more individual devices shall be permitted if all of the following conditions are met:

(1) The outlet box that supplies the device(s) is nonmetallic.
(2) The branch circuit wiring that supplies each device consists of a separate nonmetallic cable assembly originating outside the box, or individual sets of conductors in a single nonmetallic raceway, all of which originate outside the box. Other than the connections to a single device, these conductors are not spliced in the box or continued to another device, and no other wiring or raceways enter the box.
(3) Each device is capable of removal from the building surface opening without being damaged. If a special tool is required for this purpose, the applicable circuit directory for the device records the location of the tool, together with a product code/QR code for acquiring a replacement if necessary.
(4) All connections for each device to the branch circuit wiring are made with listed clamping-type wire connectors, which are supplied with the devices. The branch-circuit conductors are arranged to permit the connector(s) to be exposed after the device has been fully removed.
(5) The device assemblies are listed for this application.

(2) Boxes Larger Than 1650 cm^3 (100 in.^{3}) in Size. The openings shall not be smaller than the outer walls of the box.
(3) Conduit Bodies. The openings shall not be smaller than outer walls of the conduit body.
(B) Underground. Underground boxes and handhole enclosures shall be installed …

Issue Date: March 21, 2023

Effective Date: April 10, 2023

EN12025Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 250.114(3)e and 250.114(4)e
TIA 23-1
(SC 21-12-13 / TIA Log #1608)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise 250.114(3)e and (4)e to read as follows:

250.114 Equipment Connected by Cord and Plug. Exposed, normally non-current-carrying metal parts of cord-and-plug-connected equipment shall be connected to the equipment grounding conductor under any of the following conditions:

…

(3) In residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

(4) In other than residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

…

Page: 1

Mod_12025_Text_TIA 23-1.pdf

Issue Date: December 8, 2021

Effective Date: December 28, 2021

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Existing Building

SW11977

15

Date Submitted	02/11/2025	**Section**	302.6.2	**Proponent**	Dallas Thiesen
Chapter	3	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

Summary of Modification

Excepts Florida from the equipotential bonding requirements of 2023 NFPA 70 and preserves the status quo, allowing the continued use of single wire the single wire bonding method which has no history of failure in the 20 years that it has been in use.

Rationale

The requirements to use a copper or steel grid for the bonding of swimming pool permitter surfaces is not justified and does not provide improvements in the elimination of voltage gradients compared to existing methods. This proposal seeks to maintain the status quo single wire bonding that has been in place in Florida for 20 years. In that 20 year period there has not been a single documented case of the failure of the single wire bonding method. Additionally, it is estimated that the requirements of 2023 NFPA 70 Sec. 680.26(2)(a)-(b) will add between 2% to 10% to the cost of residential pool construction depending on copper prices and even greater costs increases for remodels having to bring the equipotential bonding up to the 2023 NFPA 70 standard.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
None
Impact to building and property owners relative to cost of compliance with code
This proposal will prevent unnecessary cost increases to consumers.
Impact to industry relative to the cost of compliance with code
This proposal will prevent unnecessary cost increases to the industry.
Impact to small business relative to the cost of compliance with code
This proposal will prevent unnecessary cost increases to the industry.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This preserves the status quo for equipotential bonding which has no record of failure in the 20 years that it has been in use in Florida.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This preserves the status quo for equipotential bonding which has no record of failure in the 20 years that it has been in use in Florida.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This prevents specification of materials an methods. NFPA 70 locks consumers and the industry in to a speicific method of compliance whereas this modification allows for multiple methods of compliance and varied use of materials.

Does not degrade the effectiveness of the code

This preserves the status quo for equipotential bonding which has no record of failure in the 20 years that it has been in use in Florida.

302.6.2 Equipotential bonding.

Any of the parts specified in Sections 680.26(B)(1) through (B)(7) of the NFPA 70, National Electrical Code that are repaired, replaced, altered, or installed new at an existing swimming pool shall be connected to the existing bonding system using solid copper conductors, insulated, covered, or bare, not smaller than 8 AWG or with rigid metal conduit of brass or other identified corrosion-resistant metal. Connections to bonded parts shall be made in accordance with Section 250.8 of NFPA 70, National Electrical Code. An 8 AWG or larger solid copper bonding conductor provided to reduce voltage gradients in the pool area shall not be required to be extended or attached to remote panelboards, service equipment, or electrodes. All metallic float-in light rings shall be connected to the equipotential bonding grid. Float-in light rings with no provision for bonding, and other devices which do not provide an electrical connection between a metallic underwater luminaire and the forming shell of a wet niche fixture, including screws or bolts not supplied by the luminaire's manufacturer and listed for use with the specific luminaire, shall not be allowed for use with any underwater luminaire that is required to be grounded. Where none of the bonded parts is in direct connection with the pool water, the pool water shall be in direct contact with an approved corrosion-resistant conductive surface that exposes not less than 9 square inches (5800 mm2) of surface area to the pool water at all times. The conductive surface shall be located where it is not exposed to physical damage or dislodgement during usual pool activities, and it shall be bonded in accordance with Section 680.26(B) of the NFPA 70, National Electrical Code. A bonded concrete pool shell shall be considered to be a conductive surface. The interior metallic surface or surfaces of any forming shell (wet niche) shall not be covered with any material, including plaster, except potting compound covering internal bonding connections in conformance with 680.23(B)(2)(b) of NFPA 70, National Electrical Code, shall be allowed.

In lieu of the requirements of NFPA 70 Sec. 680.26(2)(a)-(b) for conductive paved and unpaved swimming pool perimeter surfaces, swimming pools and spas may be bonded by single copper conductor where the following requirements are met:

(1)At least one minimum 8 AWG bare solid copper conductor shall be provided.

(2) The conductors shall follow the contour of the perimeter surface.

(3) Only listed splicing devices or exothermic welding shall be permitted.

(4) The required conductor shall be 450 mm to 600 mm (18 in. to 24 in.) from the inside walls of the pool.

(5) The required conductor shall be secured within or under the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below the subgrade.

F.E. Santos PE
5333 COLLINS AVENUE
MIAMI BEACH, Fl 33140
PE # 19522 (Electrical)
Ph: 786.367.3261.
Office: 305.688.2000.Fax: 305.688.3000.Email:shineco1@bellsouth.net

MIAMI-DADE COUNTY
BUILDING & ZONING DEPARTMENT
11805 SW 26TH Street
Miami,Fl 33175-2474
Attn: Mr. Stuart Bazerman Electrical Division Director

March 13, 2007

Ref: Resistance test for bonding installation in new Swimming Pool
Job Name: Nicolas Tempestini Residence Swimming Pool
Job address: 9821 NW 26th Street Doral,Fl

Dear Mr. Bazerman:

This is to certify that an additional Fall-of-Potential test was performed for a different bonding installation at the above address.

The bonding installation consisted of a #8 solid bare copper grid 12"x 12"and 36"wide installed around the perimeter of the pool.

All metallic components of the pool including the reinforcing rebar in the pool walls were bonded to the bonding installation at 4 places.

Copper Clad ground rods were driven adjacent to the pool area and resistance tests was performed to determine the ground continuity between the ground rods and the bonding installation.

A resistance to ground was measured for the bonding installation the results listed below showed resistance with and without copper grid, less than 25 ohms for both systems.

Tests Date: March 7, 2007 (Single # 8) and March 13, 2007(Copper grid)

Test Instruments: Biddle Series 3 Resistance Tester, Simpson 260

		(Single # 8)	(Copper grid)
Location 1:	Adjacent to north side of pool @ 8 feet	= 5.6 ohms	5.9 ohms
Location 2:	Adjacent to east side of pool @ 6 feet	= 3.4 ohms	5.4 ohms
Location 3:	Adjacent to south side of pool @ 5 feet	= 7.7 ohms	8.6 ohms

Should you have any questions regarding the above, or require additional information, please contact us.

Respectfully,

F.E. Santos, PE

Jason W Rice, P.E.
Consulting Engineer
10289 Penningcroft Lane
Mechanicsville, VA 23116
P 804-514-0743
F 804-368-7287

February 1, 2007

FSPA
Attn: Jennifer Hatfield
1718 main st. Suite 303
Sarasota, FL 34236
P 941-952-9293
F 941-366-7433

Project Location: NEC Bonding Issue

Ms. Hatfield,

I would like to take this opportunity to express my professional opinion about the equipotential bonding question as they pertain to pools. It is my opinion that the proposed language for the 2008 NEC, Section 680.26 is sufficient to reduce the potential for voltage gradients in a pool area. The section in question states that providing adequate bonding for a perimeter surface requires a single, minimum 8 AWG, bare solid copper conductor to follow the contour of the pool. This "contour bonding" shall be connected to the pool steel in at least four (4) uniformly spaced locations (except for non-conductive pool shells). Additionally, this contour bonding shall be 18-24 in. from the inside wall of the pool and secured under 4-6 in. of topsoil. All splicing and connections shall conform to NEC requirements.

I have had the opportunity as engineer of record on more than 3,000 pool related projects, both commercial and residential. Additionally, I have actively been providing electrical engineering designs in the residential, commercial and

industrial industries for the past 12 years. It is my professional opinion that the above perimeter bonding is all that is required to ensure a reduction in the potential for voltage gradients for the perimeter surfaces in a pool area.

Please don't hesitate to contact me if you have any further questions or comments.

Sincerely,

Jason W. Rice, P.E.

Attachments: 1 – Jason Rice Curriculum Vitae

Jason W. Rice, PE

Mr. Rice has over 12 years of professional experience in all aspects of governmental, institutional, commercial, industrial, residential, recreational, structural, electrical and environmental engineering. His work has traversed the United States, the Caribbean and includes the engineering of more than 3,500 projects (over 2,000 pools) and conducting over 1,000 inspections.

His He is supported by three assistants, a field technician, a GIS technician and a project engineer. The field technician is licensed as a Certified Pool Operator and a Pool & Spa Repair Contractor with over 10 years' experience in the pool industry. The GIS technician has over 10 years' of government, commercial and residential engineering experience. The project engineer is a mechanical engineer with over 15 years of design engineering experience.

Prior to his independent consulting work, Mr. Rice worked with an environmental and electrical engineering, design-build firm and several multi-disciplined, civil & MEP engineering firms. His responsibilities were in all phases of engineering, from assisting clients with conceptual layout, preliminary or forensic inspections and review, obtaining public official approval on preliminary designs, preparing the final design documents, management of construction (including inspections) to the final turnover to the client. Mr Rice's experience provides not only multi-discipline engineering design but also a firm comprehension of how these fields affect the overall scope on a project.

Commercial

Electrical, Columbia Restaurant, Sarasota, FL. The engineering design of modifications to the 1000A electrical distribution system.

Electrical, Dwyers Irish Pub, Ft Myers, FL. The engineering design of modifications to the 2000A electrical distribution system.

Electrical, Metro Coffee & Wine Club, Sarasota, FL. The engineering design of modifications to the 2500A electrical distribution system.

Electrical, Sarasota Commercial Management Office Building, Sarasota, FL. The engineering design of modifications to the 1000A electrical distribution system.

Electrical, Mariott Resort, West Palm Beach, FL. The engineering design of the modifications to a 800A electrical distribution system.

Electrical, AutoPilot Systems, Ft Lauderdale, FL. The engineering design of the modifications to the 2000A electrical distribution system.

Electrical, Lo Chlor, Ft Lauderdale, FL. The engineering design of the manufacturing control system.

Electrical, Days Inn, Port Charlotte, FL. The engineering design of the fire alarm and control system.

Electrical, Collier County Public Library, Immokalee, FL. The engineering design of the fire alarm and control system.

Registrations:
Professional
Engineer/FL/2002

Professional
Engineer/VA/2004

Professional
Engineer/MD/2004

Professional Memberships:

American Concrete Institute

Association of Pool & Spa Professionals

National Fire Prevention Association, NEC

Florida Swimming Pool Association

Community Involvement:

King's Charter Architectural Control Committee Member, 2006-2007.

Florida Swimming Pool Association, State of Florida Technical Advisor, responsible for providing technical and building code guidance on policies and represented the association at the state and national level, 2004-2006.

Conducted Building Code Training Courses for city officials, various Broward & Palm Beach County cities, FL 2004 - 2005.

Electrical, Homewood Suites by Hilton, Sarasota, FL. The engineering design of the fire alarm and control system.

Electrical, The Courtyard at Market Square, Sarasota, FL. The engineering design of the fire alarm and control system.

Electrical, Homewood Suites by Hilton, Sarasota, FL. The engineering design of the fire alarm and control system.

Water Resources, The Singer Island Resort, Singer Island, FL. a 1,500+ SF, beach entry and recreational slide swimming pool, a 850+ SF perimeter overflow formal pool and a 35+ SF spa. All of these pools are located above the parking garage and supported on a column system structural design.

Water Resources, Walt Disney World, Typhoon Lagoon, Orlando, FL, a 2000+ SF, 170,000+ gal beach entry and recreational slide swimming pool. The engineering included all hydraulic, electrical, structural and mechanical systems. Provided construction management on all phases.

Water Resources, US Marines, 29 Palms Base, Adobe Flats II Clubhouse, Ocotillo Heights Community Center, Desert View Terrace Clubhouse, Twenty-Nine Palms, CA, three (3) separate 1,200 SF, 45,000 gal pools with kiddie water feature play areas. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, Landstar-Waterstone Development, Miami, FL a 2000+ SF, 120,000+ gal pool, 200+ SF kiddie pool and 35+ SF spa. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, The Mariott Courtard, Pembroke Pines, FL, a 800+ SF, 30,000+ gal pool. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, The Aman Yara Resort, Turks & Caicos Island, a 2000+ SF, 120,000+ gal pool, 200+ SF kiddie pool and 35+ SF spa. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, Rolling Hills Golf & CC, Akron, OH, remodeling of a 1,800 SF pool and decking. The engineering included all hydraulic, electrical, structural and mechanical systems.

Water Resources, The Jungle Club, Vero Beach, FL, remodeling of a 2,800 SF pool, a 49 SF spa and a new 2,300 SF pool. The engineering included all hydraulic, electrical, structural and mechanical systems.

Drainage Design, Universal Studios, Universal's Islands of Adventure, Orlando, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system;

International Aquatics Foundation, member of IAF-7 committee, this committee is responsible for updating the national code for swimming pool standards, Washington DC, 2005

Facing It Together, non-profit organization that raises money through sponsorship of athletic events and provides monies for surgical reconstruction of facial abnormalities for disadvantaged children, Broward County, FL 2004 - 2006.

Leukemia & Lymphoma Society, non-profit organization that raises money through sponsorship of athletic events and provides monies for research into the treatment of cancer, Palm Springs, CA 2003 - 2004.

Residential

Electrical, Falcone Residence, Boca Raton, FL. The engineering design of the 1500A electrical distribution system on new residence.

Electrical, Manchester Residence, Sarasota, FL. The engineering design of the refurbishments to the 1600A electrical distribution system on an existing residence.

Electrical, Cannon Residence, Sarasota, FL. The engineering design of the refurbishments to the 600A electrical distribution system on an existing residence.

Water Resources, Brown Residence, Paradise Island, Bahamas, engineering design of 600 SF, 18,000 gal., deep foundation koi pond and multiple water features. Additionally, this project included the design of a 1,800 SF, 180,000 gal. pool, a 28 foot single-span RC bridge, a 120 SF, 4 column, grade beam and deep foundation gazebo structure, a 240 SF by 8 feet high RC and masonry deep foundation water fall structure. The engineering included all hydraulic, electrical, structural and mechanical systems. Provided construction management on all phases.

Water Resources, Venturi Residence, Ft Lauderdale, FL. Engineering design of 1,200 SF, 96,000 gal. pool and a 600 SF, two-story, RC and masonry waterfall/cave structure. A key feature of the cave was the 28 feet single span opening on one side. The engineering included all hydraulic, electrical, structural (shallow foundation) and mechanical systems. Provided construction management on all phases.

Water Resources, Smith Residence, Plantation, FL. Engineering design of 500 SF, 21,000 gal. pool and a 100 SF, two-story, RC spa and waterfall structure. The engineering included all hydraulic, electrical, structural (shallow foundation) and mechanical systems..

Municipal

Control System/Drainage Design, Gore Street Alum Treatment System, City of Orlando, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Lake Howard Alum Treatment System, City of Winter Haven, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Port Orange Alum Treatment System, City of Port Orange, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, East Lake Alum Treatment System, Hillsborough County, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Clearwater Alum Treatment System, City of Clearwater, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Winter Park Alum Treatment System, City of Winter Park, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Drainage Design, Polk County Environmental Services, Lake Blue/Lake Cannon, FL. Provided engineering design and build services for stormwater runoff monitoring, retention and alum treatment system.

Control System/Water and Sewer, Miami-Dade Water & Sewer, Alexander Orr Water Treatment Plant, Miami, FL. Complete design of temperature and vibration control systems on four, 2000 amp emergency generators. Provided installation, startup and calibration of the complete system.

Control System/Water and Sewer, East Waste Water Treatment Plant, City of Orlando, FL. Provided hydraulic and controls engineering and design of refurbishments to 100,000 GPD reuse system and annual hydraulic system testing, calibration and certification. Provided controls and electrical engineering design for activated sludge, heat-tracing system.

Control System/Water and Sewer, Bradenton Waste Water Treatment Plant, City of Bradenton, FL. Engineering design and build of methanol feed system for 35 MGD plant.

Water and Sewer, Sykes Creek Waste Water Treatment Plant, Brevard County, FL. Engineering design of rehab to 25 MGD influent structure hydraulics, monitoring and control system.

Control System/Water and Sewer, US Air Force, Tyndall AFB Waste Water Treatment Plant, Tyndall, FL. Engineering design and build of effluent hydraulic, UV treatment and control system for 100,000 GPD plant.

industrial industries for the past 12 years. It is my professional opinion that the above perimeter bonding is all that is required to ensure a reduction in the potential for voltage gradients for the perimeter surfaces in a pool area.

Please don't hesitate to contact me if you have any further questions or comments.

Sincerely,

Jason W. Rice, P.E.

Attachments: 1 – Jason Rice Curriculum Vitae

Electro-Kinetic Corporation
Licensed Electrical Contractors
1801 S. Ocean Drive Hallandale, Fl. 33009 Phone/Fax (954) 456-7889

March 8, 2007

Stu Bazerman
11805 SW 26th Street
Miami, Fl. 33175-2474

Job Name: Angie Daza
Job Address: 11103 NW 71 Terrace Doral, Fl.

Dear Mr. Bazerman,

We have inspected and tested the bonding components of the swimming pool installed at the above address. A single #8 bond wire has been installed 360 degrees around the swimming pool. This bonding conductor is 18" from the inside of the pool wall. All metallic components of the pool are bonded to this wire including the reinforcing rods in the pool walls. We certify that the installed components meet the requirements of Article 680 of the National Electric Code. Resistance tests of the bonded equipment were completed on March 7, 2007.

Copper Clad ground rods were driven adjacent to the pool area and resistance tests performed to determine the ground continuity between the ground rods and the bonded pool equipment. An acceptable resistance to ground was measured for this swimming pool bonding system (less than 25 ohms). There is no further recommendation for additional bonding methods required for this location. The results of our resistance tests of the bonded equipment are listed below.

Test Date: March 7, 2007
Test Instruments: Biddle Series 3 Resistance Tester; Simpson 260

Location 1:	Adjacent to west side of pool @ 6 feet	16.8 ohms
Location 2:	Adjacent to north side of spa @ 5 feet	12.1 ohms
Location 3:	Adjacent to south side of pool @ 6 feet	13.4 ohms

Sincerely,

George DeSalle
Florida State Certification: # EC 1767

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Existing Building

E12026

16

Date Submitted	02/11/2025	**Section**	102.4	**Proponent**	Bryan Holland
Chapter	16	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

A related modification has been submitted to the FBC-B. FBC-R, and FBC-EC to update the reference to NFPA 70-23, including all published TIAs.

Summary of Modification

This proposed modification recommends adoption of NFPA 70-23, including all published Tentative Interim Amendments (TIAs)

Rationale

This proposed modification recommends updating the adopted edition of NFPA 70 to the 2023 edition, including all published TIAs (TIA 23-1 through TIA 23-16). Tentative Interim Amendments (TIAs) are important revisions to the code that have been issued by the NFPA Standards Council after publication of the document. All issued TIAs have been reviewed and approved through consensus voting on the basis of "technical merit" and "emergency nature" by the corresponding Code Making Panel, without creating a correlation issue with any other sections of the code. For the 2023 edition of NFPA 70, TIAs 23-1 through 23-6 were issued prior to publication of the code and incorporated into the first printing. This proposed modification recommends all TIAs, 23-1 through 23-16 be officially adopted and incorporated into the code. This will help reduce conflicts in the field and improve consistent enforcement across all Florida jurisdictions.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

This proposed modification will improve the consistent enforcement of the code by the local entity.

Impact to building and property owners relative to cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Impact to industry relative to the cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Impact to small business relative to the cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The changes made to the 2023 NEC along with all issued TIAs represent important improvements and corrections to the published code. All (16) TIAs have been deemed to have both technical merit and emergency in nature, thus increasing the health, safety, and welfare of the general public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification improves the code by updating to the most current edition of the NEC and by incorporating corrections made after initial publication.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

This proposed modification improves the effectiveness of the code.

E12026Text Modification

Chapter 16 Referenced Standards

NFPA

70 - ~~20~~ 23 National Electrical Code (NEC), including all published Tentative Interim Amendments (TIAs) published until December 4, 2024

Page: 1

Mod12026_TextOfModification.pdf

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Definition of Pool, and 680.26
TIA 23-9
(SC 23-3-8 / TIA Log #1687)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise the definition of "Pool" to read as follows:

Pool. Manufactured or field-constructed equipment designed to contain water on a permanent or semipermanent basis and used by persons for swimming, wading, immersion, or therapeutic purposes, but not including bodies of water incorporated as part of an industrial process or lakes, lagoons, surf parks, or other natural and man-made bodies of water that may incorporate swimming and swimming areas. (680) (CMP-17)

Informational Note: Natural and man-made bodies of water, which includes lakes, lagoons, surf parks, or other similar bodies of water, are addressed in Article 682.

2. Revise section paragraph 680.26 to read as follows:

680.26 Equipotential Bonding.
(A) Performance. The equipotential bonding required by 680.26(B) and (C) to reduce voltage gradients in the pool area shall be installed for pools with or without associated electrical equipment related to the pool.

Informational Note No. 1: Some causes of voltage gradients originate outside the premises wiring system and are not within the scope of the *NEC*. Measures identified in Rule 097D2 of ANSI C2, *National Electrical Safety Code*, can also serve to address voltage gradients originating on the utility side of the service point.

Informational Note No. 2: By its nature, equipotential bonding of swimming pools and perimeter surfaces involves contact between various metallic materials and the earth. This can, in some cases, expose various specific metals to a corrosive environment, depending on factors such as the type and chemical content of the soil and the specific metal. Corrosive environments are also addressed in 680.14.

(B) Bonded Parts. …

(1) Conductive Pool Shells. …

(2) Perimeter Surfaces. The perimeter surface to be bonded shall be considered to extend for ~~1 m~~ 900 mm (3 ft) horizontally beyond the inside walls of the pool ~~and~~ while also at a height between 900 mm (3 ft) above and 600 mm (2 ft) below the maximum water level. The perimeter surface shall include unpaved surfaces, concrete, and other types of paving. Perimeter surfaces separated from the pool by a permanent wall or building 1.5 m (5 ft) in height or more shall

require equipotential bonding only on the pool side of the permanent wall or building. Bonding to perimeter surfaces shall be provided as specified in 680.26(B)(2)(a), (B)(2)(b), ~~or~~ (B)(2)(c), and (B)(2)(d). ~~and~~ For conductive pool shells where bonding to perimeter surfaces is required, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four points uniformly spaced around the perimeter of the pool, or if the bonded perimeter surface does not surround the entire pool, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four uniformly spaced points along the bonded perimeter surface. For nonconductive pool shells where bonding to the perimeter surfaces is required, bonding at four points shall not be required, and the perimeter bonding shall be attached to the 8 AWG copper equipotential bonding conductor and, if present, to any conductive support structure for the pool.

> Informational Note: Because the perimeter surface can incorporate various types of materials at various locations and elevations above and below maximum water level, the perimeter surface required to be bonded might not surround the entire pool. The 8 AWG copper equipotential bonding conductor can encircle the entire pool to facilitate connection of bonded parts.

(a) ~~*Structural Reinforcing Steel.* Structural reinforcing steel shall be bonded in accordance with 680.26(B)(1)(a).~~ *Conductive Paved Portions of Perimeter Surfaces.* Conductive paved portions of perimeter surfaces, including masonry pavers, if used, shall be bonded with unencapsulated structural reinforcing steel in accordance with 680.26(B)(1)(a), or with unencapsulated steel structural welded wire reinforcement (welded wire mesh, welded wire fabric), bonded together by steel tie wires or the equivalent. Steel welded wire reinforcement shall be fully embedded within the pavement unless the pavement will not allow for embedding. If the reinforcing steel is absent, or is encapsulated in a nonconductive compound, or embedding is not possible, unencapsulated welded wire steel reinforcement or a copper conductor grid shall be provided and shall be secured directly under the paving, and not more than 150 mm (6 in.) below finished grade.

Unencapsulated steel welded wire reinforcement that is not fully embedded in concrete, and copper grid regardless of location, where used for equipotential bonding, shall be listed for corrosion resistance and mechanical performance. This listing requirement shall become effective January 1, 2025. The copper grid or unencapsulated steel welded wire reinforcement shall also meet the following:

(1) Copper grid is constructed of 8 AWG solid bare copper and arranged in accordance with 680.26(B)(1)(b)(3).
(2) Steel welded wire reinforcement is minimum ASTM 6x6-W2.0 x W2.0 or minimum No. 3 rebar constructed in a 300 mm (12 in.) grid.
(3) Copper grid and steel welded wire reinforcement follow the contour of the perimeter surface extending not less than 900 mm (3 ft) horizontally beyond the inside walls of the pool.
(4) Only listed splicing devices or exothermic welding are used.

> Informational Note No. 1: Performance of the equipotential bonding system at the perimeter surface is improved as the distance between the bonding means and finished grade is minimized, either by embedding within, or by direct contact with the underside of, the finished pavement.

> Informational Note No. 2: See ASTM A615/A615M, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement;* A1064/A1064M, *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete;* A1022/A1022M, *Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement;* A1060A/A1060M, *Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete;* and ACI Standard ACI 318, *Building Code Requirements for Structural Concrete,* for examples of standards currently used in the listing of reinforcing steel bars and steel welded wire reinforcement.

(b) *Unpaved Portions of Perimeter Surfaces.* Unpaved portions of perimeter surfaces shall be bonded with any of the following methods:
(1) ~~*Copper Ring.* Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, a c~~Copper conductor(s) shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. At least one minimum 8 AWG bare solid copper conductor, including the 8 AWG copper equipotential bonding conductor if available ~~shall be provided~~.
~~(2)~~b. The conductors ~~shall~~ follow the contour of the perimeter surface.
~~(3)~~c. Only listed splicing devices or exothermic welding are used. ~~shall be permitted.~~
~~(4)~~d. The ~~required~~ conductor(s) is ~~shall be~~ 450 mm to 600 mm (18 in. to 24 in.) from the inside walls of the pool.
~~(5)~~e. The ~~required~~ conductor(s) ~~shall be secured within or~~ is under the unpaved portion of the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.
f. Be installed only in perimeter surfaces not intended to have direct access to swimmers in the pool.

(~~c~~2) ~~*Copper Grid*. Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound,~~ ~~c~~Copper grid or unencapsulated steel welded wire reinforcement used for equipotential bonding of unpaved portions of perimeter surfaces shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. ~~The copper grid shall be constructed of 8 AG solid bare copper and be arranged~~ Be installed in accordance with 680.26~~(B)(1)(b)(3)~~(B)(2)(a).
~~(2) The copper grid shall follow the contour of the perimeter surface extending 1 m (3 ft) horizontally beyond the inside walls of the pool.~~
~~(3) Only listed splicing devices or exothermic welding shall be permitted.~~
~~(4)~~b. ~~The copper grid shall be secured~~ Be located within ~~or under~~ the ~~deck or~~ unpaved surface(s) between 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.

(c) *Nonconductive Perimeter Surfaces.* Equipotential bonding shall not be required for nonconductive portions of perimeter surfaces that are separated from earth or raised on nonconducting supports, and it shall not be required for any perimeter surface that is electrically separated from the pool structure and raised on nonconductive supports above an equipotentially bonded surface.

Informational Note: Nonconductive materials include, but are not limited to, wood, plastic, wood-plastic composites, fiberglass, and fiberglass composites.

(d) *Interconnection of Bonded Portions of Perimeter Surfaces.* All surfaces where equipotential bonding is required shall be interconnected using listed splicing devices or exothermic welding. Where copper wire is used for this purpose, it shall be solid copper, not smaller than 8 AWG. The conductor shall be permitted to encircle the pool to facilitate bonding connections to portions of the perimeter covered in 680.26(B)(2)(a) and (B)(2)(b) that are not contiguous.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 300.26
TIA 23-8
(SC 23-3-9 / TIA Log #1688)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by the NEC Code-Making Panel 3 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 300.26 to read as follows:

300.26 Remote-Control and Signaling Circuits Classification.
Remote-control and signaling circuits shall be classified as either power-limited or non-power-limited and comply with ~~the following~~300.26(A) through (C).

(~~1~~A) **Class 1 Power-Limited Remote-Control and Signaling Circuits**. Class 1 power-limited remote-control and signaling circuits shall comply with 724.3.

(~~2~~B) **Class 2 and Class 3 Power-Limited Remote-Control and Signaling Circuits**. Class 2 and Class 3 power-limited remote-control and signaling circuits shall comply with 725.3.

(~~3~~C) **Non-Power-Limited Remote-Control and Signaling Circuits**. Non-power-limited remote-control and signaling circuits shall be installed in accordance with 300.2 through 300.25 and comply with 300.26(C)(1) through (C)(3).

(1) Sizes and Use.

(a) Conductors that are 18 AWG and 16 AWG copper shall be permitted to be used if they supply loads that do not exceed the ampacities specified in 402.5 and are installed in a raceway, an approved enclosure, or a listed cable.

(b) Conductors that are 14 AWG copper-clad aluminum shall be permitted to be used in Type MC cable and Type TC cable. The continuous load shall not exceed 8 amperes.

(c) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall not supply loads greater than the ampacities specified in 310.14.

(d) Flexible cords shall comply with the applicable general requirements, applications, and construction specifications for flexible cords and flexible cables in accordance with Article 400 Parts I and II.

(2) Insulation.

(a) Insulation on conductors shall be rated for the system voltage and not less than 600 volts.

(b) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall comply with the applicable general requirements for conductors rated up to and including 2000 volt for type designations, insulations, markings, ampacity ratings, and uses in accordance with 310.3, 310.4, 310.6, 310.8, 310.10, and 310.14.

(c) Conductors that are 18 AWG copper, 16 AWG copper, or 14 AWG copper-clad aluminum shall be Type FFH-2, Type KF-2, Type KFF-2, Type PAF, Type PAFF, Type PF, Type PFF, Type PGF, Type PGFF, Type PTF, Type PTFF, Type RFH-2, Type RFHH-2, Type RFHH-3, Type SF-2, SFF-2, Type TF, Type TFF, Type TFFN, Type TFN, Type ZF, or Type ZFF.

(d) Conductors with other types and thicknesses of insulation shall be permitted if listed for Class 1 circuit use.

(3) Overcurrent Protection.

(a) Overcurrent protection for conductors 14 AWG copper and larger shall be provided in accordance with the conductor ampacity, without applying the ampacity adjustment and correction factors specified in 310.15 to the ampacity calculation.

(b) Overcurrent protection shall not exceed 7 amperes for 18 AWG copper conductors and 10 amperes for 16 AWG copper and 14 AWG copper-clad aluminum.

Exception: The overcurrent protection specified in 300.26(C)(3)(1) and 300.26(C)(3)(2) shall not be required where this Code requires or permits other overcurrent protection ratings.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo**)**

E12026Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Table C.18, Table C.19 and Table C.20
TIA 23-7
(SC 22-12-7 / TIA Log #1678)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 8, and the NEC Correlating Committee, and was issued by the Standards Council on December 8, 2022, with an effective date of December 28, 2022.

*1. Revise Table Headers **only** for Table C.18, Table, C.19 and Table C.20 to read as follows:*

Table C.18 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.19 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.20 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Issue Date: December 8, 2022

Effective Date: December 28, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 555.35
TIA 23-6
(SC 22-8-23 / TIA Log #1660)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.35 to read as follows:

555.35 Ground-Fault Protection of Equipment (GFPE) and Ground-Fault Circuit Interrupter. For other than floating buildings, ground-fault protection for docking facilities shall be provided in accordance with 555.35(A) through (~~F~~D).

~~**(A) Sources Directly Supplying Docking Facilities or Wharfs.** Listed GFPE, rated not more than 100 milliamperes, shall be provided for sources directly supplying all docking facilities or wharfs. Coordination with downstream GFPE shall be permitted.~~

(~~B~~A) Feeder. …

Exception: Transformer secondary conductors of a separately derived system that do not exceed 3 m (10 ft) and are installed in a raceway shall be permitted to be installed without ground-fault protection. This exception shall also apply to the supply terminals of the equipment supplied by the transformer secondary conductors.

(~~C~~B) Branch-Circuits.

(1) Receptacles Providing Shore Power. …

(2) Outlets for Other than Shore Power. Outlets supplied by branch circuits not exceeding 150 volts to ground and 60 amperes, single phase, and 150 volts or less to ground, 100 amperes or less, three phase, shall be provided with GFCI protection for personnel.

Exception to (~~C~~B): Low-voltage circuits not requiring grounding, not exceeding the low-voltage contact limit and supplied by listed transformers or power supplies that comply with 680.23(A)(2) shall be permitted to be installed without ground-fault protection.

(~~D~~C) Boat Hoists. …

(~~E~~D) Leakage Current Measurement Device. …

Informational Note No. 1: …

Informational Note No. 2: …

Exception: Where the shore power equipment includes a leakage indicator and leakage alarm, a separate leakage test device shall not be required.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

E12026Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 555.30
TIA 23-5
(SC 22-8-22 / TIA Log #1659)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.30 to read as follows:

555.30 Electrical Equipment and Connections.

(A) General. All <u>electrical components within</u> electrical equipment (excluding wiring methods) and connections not intended for operation while submerged shall be located at least 305 mm (12 in.) above the deck of a fixed or floating structure, but not below the electrical datum plane. Conductor splices, within junction boxes identified for wet locations, utilizing sealed wire connector systems listed and identified for submersion shall be required for floating structures where located above the waterline but below the electrical datum plane.

(B) Replacements. …

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 215.15
TIA 23-4
(SC 22-8-18 / TIA Log #1655)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 215.15 to read as follows:

215.15 Barriers. Barriers shall be placed such that no energized, uninsulated, ungrounded busbar or terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations in panelboards, switchboards, switchgear, or motor control centers supplied by feeder taps in 240.21(B) or transformer secondary conductors in 240.21(C) when the disconnecting device, to which the tap conductors are terminated, is in the open position.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

E12026Text Modification

Tentative Interim Amendment

NFPA® 70®

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2023 Edition

Reference: 210.8(F) and Exception No. 2(new)
TIA 23-3
(SC 22-8-17 / TIA Log #1654)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 210.8(F) to read as follows:

210.8(F) Outdoor Outlets.
For dwellings, all outdoor outlets, other than those covered in 210.8(A), Exception No. 1, including outlets installed in the following locations, and supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, shall be provided with GFCI protection:

(1) Garages that have floors located at or below grade level
(2) Accessory buildings
(3) Boathouses

If equipment supplied by an outlet covered under the requirements of this section is replaced, the outlet shall be supplied with GFCI protection.

Exception No. 1: GFCI protection shall not be required on lighting outlets other than those covered in 210.8(C).
Exception No. 2: GFCI protection shall not be required for listed HVAC equipment. This exception shall expire September 1, 2026.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Mod_12026_Text_TIA 23-3.pdf

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Article 100 (Ignitible Fibers/Flyings), 506.5, and 506.9(B)
TIA 23-2
(SC 22-4-8 / TIA Log #1617)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise Article 100 Ignitible Fibers/Flyings to read as follows:

Ignitible Fibers/Flyings. Fibers/flyings where any dimension is greater than 500 μm in nominal size, which are not likely to be in suspension in quantities to produce an explosible mixture, but could produce an ignitible layer fire hazard. [**499:**3.3.4.2]

Informational Note No.1: This definition and Informational Note No. 2 have been extracted from NFPA 499-2021, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.* The NFPA 499 reference is in brackets. Only editorial changes were made to the extracted text to make it consistent with this *Code.*

Informational Note No. 2: Section 500.5 of this *Code* prescribes a Class III location as one where ignitible fibers/flyings are present, but not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. This description addresses fibers/flyings that do not present a flash-fire hazard or explosion hazard by test. This could be because those fibers/flyings are too large or too agglomerated to be suspended in air in sufficient concentration, or at all, under typical test conditions. Alternatively, this could be because they burn so slowly that, when suspended in air, they do not propagate combustion at any concentration. In this document the zone classification system includes ignitible fibers/flyings as a fire hazard in a layer, which is not addressed in the IEC zone system (see IEC 60079-10-2, *Explosive atmospheres — Part 10-2: Classification of areas — Explosive dust atmospheres*). Where these are present, the user could also consider installation in accordance with Article 503 of this *Code.* [**499:**A.3.3.4.2]

2. Revise Section 506.5 to read as follows:

506.5 Classification of Locations.

(A) Classifications of Locations. …

(B) Zone 20, Zone 21, and Zone 22 Locations. …

(1) Zone 20. A Zone 20 location is a location where one of the following apply:

(1) Ignitible concentrations of combustible dust~~, or~~ combustible fibers/flyings, or ignitible fibers/flyings are present continuously or for long periods of time.

…

(2) Zone 21. …

(3) Zone 22. A Zone 22 location is a location where one of the following apply:

(1) …

(2) Combustible dust, combustible fibers/flyings, or ignitible fibers/flyings are handled, processed, or used…

(3) …

3. Revise Section 506.9(B) to read as follows:

506.9 Equipment Requirements.

…

(B) Listing. Equipment that is listed for Zone 20 shall be permitted in a Zone 21 or Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying. Equipment that is listed for Zone 21 ~~can be used~~ shall be permitted in a Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying.

Issue Date: April 12, 2022

Effective Date: May 2, 2022

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 680.43, Exception No. 3
TIA 23-16
(SC 24-12-6 / TIA Log #1800)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17, and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on December 4, 2024, with an effective date of December 24, 2024.

1. Delete Exception No. 3 of 680.43 as follows:

680.43 Indoor Installations. A spa or hot tub installed indoors shall comply with the provisions of Parts I and II of this article except as modified by this section and shall be connected by the wiring methods of Chapter 3.

Exception No. 1: Listed spa and hot tub …

Exception No. 2: The equipotential bonding …

~~*Exception No. 3: For a dwelling unit(s) only, where a listed spa or hot tub is installed indoors, the wiring method requirements of 680.42(C) shall also apply.*~~

Issue Date: December 4, 2024

Effective Date: December 24, 2024

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

E12026Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 210.70
TIA 23-15
(SC 23-11-10/ TIA Log #1753)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 2, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 210.70 to read as follows:

210.70 Lighting Outlets Required. Lighting outlets shall be installed where specified in 210.70(A), (B), and (C). The switch or listed wall-mounted control device shall not rely exclusively on ~~a~~ battery power unless ~~a~~ it incorporates a positive means of notification of impending battery depletion. ~~is provided for automatically energizing the lighting outlets upon battery failure.~~

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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E12026Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 517.30(B)(3)(a)
TIA 23-14
(SC 23-11-9 / TIA Log #1752)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 15, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 517.30(B)(3)(a) to read as follows:

517.30(B)(3) Fuel Cell Systems. Fuel cell systems shall be permitted to serve as the alternate power source for all or part of an EES. [**99:**6.7.1.5.1]

(a) Installation of fuel cells shall comply with the requirements in Parts I through VI ~~VII~~ of Article 692 ~~for 1000 volts or less and Part VIII for over 1000 volts~~.

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Mod_12026_Text_TIA 23-14.pdf

E12026Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 400.47
TIA 23-13
(SC 23-8-57 / TIA Log #1731)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by Code-Making Panel 6 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise section 400.47 to read as follows:

400.47. ~~Minimum~~ Conductor Bending ~~Radii~~ Radius. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 2000 volts to 5000 volts shall not ~~exceed~~ be bent to a radius less than six times the overall cable outer diameter. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 5001 volts to 25,000 volts shall not ~~exceed~~ be bent to a radius less than eight-times the overall cable outer diameter.

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Mod_12026_Text_TIA 23-13.pdf

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

E12026Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 408.6
TIA 23-12
(SC 23-8-56 / TIA Log #1699)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by Code-Making Panel 9 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 408.6 to read as follows:

408.6 Short-Circuit Current Rating. Switchboards, switchgear, and panelboards shall have a short-circuit current rating not less than the available fault current. In other than one- and two-family dwelling units, the available fault current and the date the calculation was performed shall be field marked on the enclosure at the point of supply. The marking shall be of sufficient durability to withstand the environment involved. ~~comply with 110.21(B)(3).~~

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Mod_12026_Text_TIA 23-12.pdf

E12026Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 700.32(C), 701.32(C), and 708.54(C)
TIA 23-11
(SC 23-8-54 / TIA Log #1692)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by Code-Making Panel 13 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 700.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

700.32 Selective Coordination.

700.32(A) General. Emergency system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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

700.32(B) Replacements. Where emergency system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

700.32(C) Modifications. If modifications, additions, or deletions to the emergency system(s) occur, selective coordination of the emergency system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 700.32~~(C)~~ for an example of how emergency system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~

~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~

~~OCPD F selectively coordinates with OCPD E.~~

~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.~~

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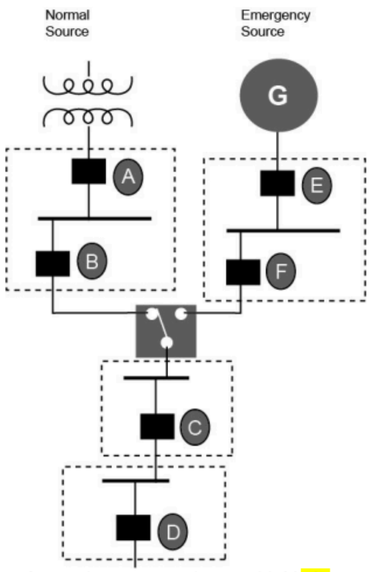
Mod_12026_Text_TIA 23-11.pdf

E12026Text Modification



Informational Note Figure 700.32~~(C)~~ Emergency System Selective Coordination.
<u>OCPD D selectively coordinates with OCPDs C, F, E, B, and A.</u>
<u>OCPD C selectively coordinates with OCPDs F, E, B, and A.</u>
<u>OCPD F selectively coordinates with OCPD E.</u>
<u>OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.</u>

2. Revise 701.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

701.32 Selective Coordination.

701.32(A) General. Legally required standby system(s) overcurrent protective devices (OCPDs shall be selectively coordinated with all supply-side and load-side OCPDs.

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

701.32(B) Replacements. Where legally required standby OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

701.32(C) Modifications. If modifications, additions, or deletions to the legally required standby system(s) occur, selective coordination of the legally required system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 701.32~~(C)~~ for an example of how legally required standby system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.~~

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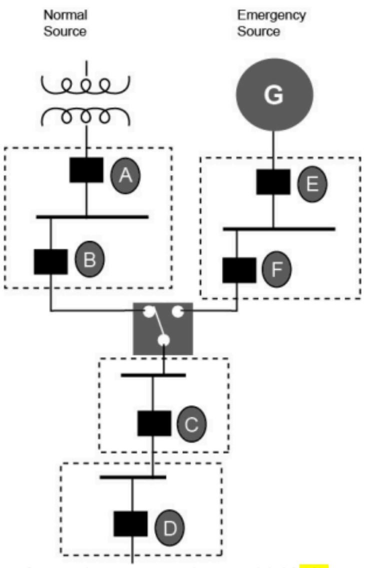
E12026Text Modification



Informational Note Figure 701.32~~(C)~~ Legally Required Standby System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.

3. Revise 708.54(C) Informational Note and title of Figure for the Informational Note to read as follows:

708.54(A) General. Critical operations power system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.
Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.
708.54(B) Replacements. Where critical operations power system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.
708.54(C) Modifications. If modifications, additions, or deletions to the critical operations power system(s) occur, selective coordination of the critical operations power system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.
Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.

Informational Note: See Informational Note Figure 708.54~~(C)~~ for an example of how critical operations power system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.~~

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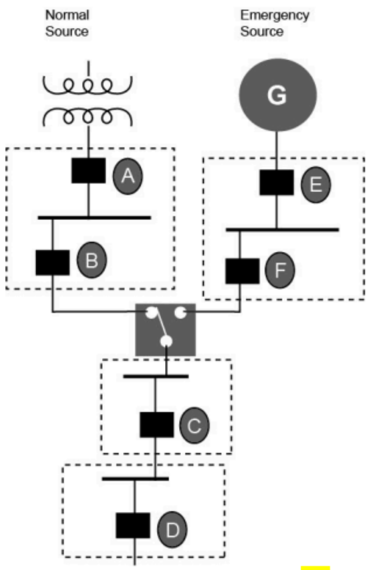
Mod_12026_Text_TIA 23-11.pdf

E12026Text Modification



Informational Note Figure 708.54~~(C)~~ Critical Operations Power System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Mod_12026_Text_TIA 23-11.pdf

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 314.29(A)
TIA 23-10
(SC 23-3-10 / TIA Log #1690)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 9 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 314.29(A) to read as follows:

314.29 Boxes, Conduit Bodies, and Handhole Enclosures to Be Accessible. Boxes, conduit bodies, and handhole enclosures shall be installed so that wiring and devices contained in the boxes, conduit bodies, or handhole enclosures can be rendered accessible in accordance with 314.29(A) and (B).

(A) In Buildings and Other Structures. Boxes and conduit bodies shall be installed so the contained wiring and devices are accessible. <u>Boxes and conduit bodies that are recessed into or behind finished surfaces of buildings shall have access to their internal contents maintained by openings in their covers and in the building finish that comply with 314.29(A)(1), (A)(2), or (A)(3) as applicable. Removable finished covers and faceplates that maintain this access shall be permitted.</u>

<u>**(1) Boxes 1650 cm³ (100 in.³) or Less in Size.** The openings in the building surfaces, if reduced from the outer walls of the box, shall be centered not more than 25 mm (1 in.) from the centerline of the box, and shall not extend beyond the walls of the box. If rectangular, the opening shall be not less than 73 mm (2 7/8 in.) by 45 mm (1 3/4 in.) in size. If circular, the opening shall not be less than 90 mm (3½ in.) in diameter.</u>

<u>*Exception: Smaller openings in building surfaces that accommodate one or more individual devices shall be permitted if all of the following conditions are met:*</u>

(1) <u>The outlet box that supplies the device(s) is nonmetallic.</u>
(2) <u>The branch circuit wiring that supplies each device consists of a separate nonmetallic cable assembly originating outside the box, or individual sets of conductors in a single nonmetallic raceway, all of which originate outside the box. Other than the connections to a single device, these conductors are not spliced in the box or continued to another device, and no other wiring or raceways enter the box.</u>
(3) <u>Each device is capable of removal from the building surface opening without being damaged. If a special tool is required for this purpose, the applicable circuit directory for the device records the location of the tool, together with a product code/QR code for acquiring a replacement if necessary.</u>
(4) <u>All connections for each device to the branch circuit wiring are made with listed clamping-type wire connectors, which are supplied with the devices. The branch-circuit conductors are arranged to permit the connector(s) to be exposed after the device has been fully removed.</u>
(5) <u>The device assemblies are listed for this application.</u>

<u>**(2) Boxes Larger Than 1650 cm³ (100 in.³) in Size.** The openings shall not be smaller than the outer walls of the box.</u>
<u>**(3) Conduit Bodies.** The openings shall not be smaller than outer walls of the conduit body.</u>
(B) Underground. Underground boxes and handhole enclosures shall be installed …

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

E12026Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 250.114(3)e and 250.114(4)e
TIA 23-1
(SC 21-12-13 / TIA Log #1608)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. *Revise 250.114(3)e and (4)e to read as follows:*

250.114 Equipment Connected by Cord and Plug. Exposed, normally non-current-carrying metal parts of cord-and-plug-connected equipment shall be connected to the equipment grounding conductor under any of the following conditions:

…

(3) In residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

(4) In other than residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

…

Issue Date: December 8, 2021

Effective Date: December 28, 2021

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Mod_12026_Text_TIA 23-1.pdf

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Mechanical

M12027

17

Date Submitted	02/11/2025	**Section**	102.4	**Proponent**	Bryan Holland
Chapter	15	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

A related modification has been submitted to the FBC-B, FBC-R, FBC-EC, and FBC-EB to update the reference to NFPA 70-23, including all published TIAs.

Summary of Modification

This proposed modification recommends adoption of NFPA 70-23, including all published Tentative Interim Amendments (TIAs)

Rationale

This proposed modification recommends updating the adopted edition of NFPA 70 to the 2023 edition, including all published TIAs (TIA 23-1 through TIA 23-16). Tentative Interim Amendments (TIAs) are important revisions to the code that have been issued by the NFPA Standards Council after publication of the document. All issued TIAs have been reviewed and approved through consensus voting on the basis of "technical merit" and "emergency nature" by the corresponding Code Making Panel, without creating a correlation issue with any other sections of the code. For the 2023 edition of NFPA 70, TIAs 23-1 through 23-6 were issued prior to publication of the code and incorporated into the first printing. This proposed modification recommends all TIAs, 23-1 through 23-16 be officially adopted and incorporated into the code. This will help reduce conflicts in the field and improve consistent enforcement across all Florida jurisdictions.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
This proposed modification will improve the consistent enforcement of the code by the local entity.

Impact to building and property owners relative to cost of compliance with code
This proposed modification will not change the cost of compliance with code.

Impact to industry relative to the cost of compliance with code
This proposed modification will not change the cost of compliance with code.

Impact to small business relative to the cost of compliance with code
This proposed modification will not change the cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The changes made to the 2023 NEC along with all issued TIAs represent important improvements and corrections to the published code. All (16) TIAs have been deemed to have both technical merit and emergency in nature, thus increasing the health, safety, and welfare of the general public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification improves the code by updating to the most current edition of the NEC and by incorporating corrections made after initial publication.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

This proposed modification improves the effectiveness of the code.

M12027Text Modification

Chapter 15 Referenced Standards

NFPA

70 - ~~20~~ 23 National Electrical Code (NEC), including all published Tentative Interim Amendments (TIAs) published until December 4, 2024

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Mod12027_TextOfModification.pdf

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Definition of Pool, and 680.26
TIA 23-9
(SC 23-3-8 / TIA Log #1687)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise the definition of "Pool" to read as follows:

Pool. Manufactured or field-constructed equipment designed to contain water on a permanent or semipermanent basis and used by persons for swimming, wading, immersion, or therapeutic purposes, but not including bodies of water incorporated as part of an industrial process or lakes, lagoons, surf parks, or other natural and man-made bodies of water that may incorporate swimming and swimming areas. (680) (CMP-17)

> **Informational Note:** Natural and man-made bodies of water, which includes lakes, lagoons, surf parks, or other similar bodies of water, are addressed in Article 682.

2. Revise section paragraph 680.26 to read as follows:

680.26 Equipotential Bonding.

(A) Performance. The equipotential bonding required by 680.26(B) and (C) to reduce voltage gradients in the pool area shall be installed for pools with or without associated electrical equipment related to the pool.

> Informational Note No. 1: Some causes of voltage gradients originate outside the premises wiring system and are not within the scope of the *NEC*. Measures identified in Rule 097D2 of ANSI C2, *National Electrical Safety Code,* can also serve to address voltage gradients originating on the utility side of the service point.

> Informational Note No. 2: By its nature, equipotential bonding of swimming pools and perimeter surfaces involves contact between various metallic materials and the earth. This can, in some cases, expose various specific metals to a corrosive environment, depending on factors such as the type and chemical content of the soil and the specific metal. Corrosive environments are also addressed in 680.14.

(B) Bonded Parts. …

(1) Conductive Pool Shells. …

(2) Perimeter Surfaces. The perimeter surface to be bonded shall be considered to extend for ~~1 m~~ 900 mm (3 ft) horizontally beyond the inside walls of the pool ~~and~~ while also at a height between 900 mm (3 ft) above and 600 mm (2 ft) below the maximum water level. The perimeter surface shall include unpaved surfaces, concrete, and other types of paving. Perimeter surfaces separated from the pool by a permanent wall or building 1.5 m (5 ft) in height or more shall

require equipotential bonding only on the pool side of the permanent wall or building. Bonding to perimeter surfaces shall be provided as specified in 680.26(B)(2)(a), (B)(2)(b), ~~or~~ (B)(2)(c), and (B)(2)(d). ~~and~~ For conductive pool shells where bonding to perimeter surfaces is required, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four points uniformly spaced around the perimeter of the pool, or if the bonded perimeter surface does not surround the entire pool, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four uniformly spaced points along the bonded perimeter surface. For nonconductive pool shells where bonding to the perimeter surfaces is required, bonding at four points shall not be required, and the perimeter bonding shall be attached to the 8 AWG copper equipotential bonding conductor and, if present, to any conductive support structure for the pool.

> Informational Note: Because the perimeter surface can incorporate various types of materials at various locations and elevations above and below maximum water level, the perimeter surface required to be bonded might not surround the entire pool. The 8 AWG copper equipotential bonding conductor can encircle the entire pool to facilitate connection of bonded parts.

(a) ~~*Structural Reinforcing Steel.* Structural reinforcing steel shall be bonded in accordance with 680.26(B)(1)(a).~~ *Conductive Paved Portions of Perimeter Surfaces.* Conductive paved portions of perimeter surfaces, including masonry pavers, if used, shall be bonded with unencapsulated structural reinforcing steel in accordance with 680.26(B)(1)(a), or with unencapsulated steel structural welded wire reinforcement (welded wire mesh, welded wire fabric), bonded together by steel tie wires or the equivalent. Steel welded wire reinforcement shall be fully embedded within the pavement unless the pavement will not allow for embedding. If the reinforcing steel is absent, or is encapsulated in a nonconductive compound, or embedding is not possible, unencapsulated welded wire steel reinforcement or a copper conductor grid shall be provided and shall be secured directly under the paving, and not more than 150 mm (6 in.) below finished grade.

Unencapsulated steel welded wire reinforcement that is not fully embedded in concrete, and copper grid regardless of location, where used for equipotential bonding, shall be listed for corrosion resistance and mechanical performance. This listing requirement shall become effective January 1, 2025. The copper grid or unencapsulated steel welded wire reinforcement shall also meet the following:

(1) Copper grid is constructed of 8 AWG solid bare copper and arranged in accordance with 680.26(B)(1)(b)(3).
(2) Steel welded wire reinforcement is minimum ASTM 6x6-W2.0 x W2.0 or minimum No. 3 rebar constructed in a 300 mm (12 in.) grid.
(3) Copper grid and steel welded wire reinforcement follow the contour of the perimeter surface extending not less than 900 mm (3 ft) horizontally beyond the inside walls of the pool.
(4) Only listed splicing devices or exothermic welding are used.

> Informational Note No. 1: Performance of the equipotential bonding system at the perimeter surface is improved as the distance between the bonding means and finished grade is minimized, either by embedding within, or by direct contact with the underside of, the finished pavement.

> Informational Note No. 2: See ASTM A615/A615M, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement;* A1064/A1064M, *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete;* A1022/A1022M, *Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement;* A1060A/A1060M, *Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete;* and ACI Standard ACI 318, *Building Code Requirements for Structural Concrete,* for examples of standards currently used in the listing of reinforcing steel bars and steel welded wire reinforcement.

(b) *Unpaved Portions of Perimeter Surfaces.* Unpaved portions of perimeter surfaces shall be bonded with any of the following methods:
(1) ~~*Copper Ring.* Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, a c~~Copper conductor(s) shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. At least one minimum 8 AWG bare solid copper conductor, including the 8 AWG copper equipotential bonding conductor if available ~~shall be provided~~.
~~(2)~~b. The conductors ~~shall~~ follow the contour of the perimeter surface.
~~(3)~~c. Only listed splicing devices or exothermic welding are used. ~~shall be permitted.~~
~~(4)~~d. The ~~required~~ conductor(s) is ~~shall be~~ 450 mm to 600 mm (18 in. to 24 in.) from the inside walls of the pool.
~~(5)~~e. The ~~required~~ conductor(s) ~~shall be secured within or~~ is under the unpaved portion of the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.
f. Be installed only in perimeter surfaces not intended to have direct access to swimmers in the pool.

(~~e~~2) ~~*Copper Grid*. Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound,~~ ~~c~~Copper grid or unencapsulated steel welded wire reinforcement used for equipotential bonding of unpaved portions of perimeter surfaces shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. ~~The copper grid shall be constructed of 8 AG solid bare copper and be arranged~~ Be installed in accordance with 680.26~~(B)(1)(b)(3)~~(B)(2)(a).
~~(2) The copper grid shall follow the contour of the perimeter surface extending 1 m (3 ft) horizontally beyond the inside walls of the pool.~~
~~(3) Only listed splicing devices or exothermic welding shall be permitted.~~
~~(4)~~b. ~~The copper grid shall be secured~~ Be located within ~~or under~~ the ~~deck or~~ unpaved surface(s) between 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.

(c) *Nonconductive Perimeter Surfaces.* Equipotential bonding shall not be required for nonconductive portions of perimeter surfaces that are separated from earth or raised on nonconducting supports, and it shall not be required for any perimeter surface that is electrically separated from the pool structure and raised on nonconductive supports above an equipotentially bonded surface.

Informational Note: Nonconductive materials include, but are not limited to, wood, plastic, wood-plastic composites, fiberglass, and fiberglass composites.

(d) *Interconnection of Bonded Portions of Perimeter Surfaces.* All surfaces where equipotential bonding is required shall be interconnected using listed splicing devices or exothermic welding. Where copper wire is used for this purpose, it shall be solid copper, not smaller than 8 AWG. The conductor shall be permitted to encircle the pool to facilitate bonding connections to portions of the perimeter covered in 680.26(B)(2)(a) and (B)(2)(b) that are not contiguous.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 300.26
TIA 23-8
(SC 23-3-9 / TIA Log #1688)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by the NEC Code-Making Panel 3 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 300.26 to read as follows:

300.26 Remote-Control and Signaling Circuits Classification.
Remote-control and signaling circuits shall be classified as either power-limited or non-power-limited and comply with ~~the following~~300.26(A) through (C).

(~~1~~A) **Class 1 Power-Limited Remote-Control and Signaling Circuits**. Class 1 power-limited remote-control and signaling circuits shall comply with 724.3.

(~~2~~B) **Class 2 and Class 3 Power-Limited Remote-Control and Signaling Circuits**. Class 2 and Class 3 power-limited remote-control and signaling circuits shall comply with 725.3.

(~~3~~C) **Non-Power-Limited Remote-Control and Signaling Circuits**. Non-power-limited remote-control and signaling circuits shall be installed in accordance with 300.2 through 300.25 and comply with 300.26(C)(1) through (C)(3).

(1) Sizes and Use.

(a) Conductors that are 18 AWG and 16 AWG copper shall be permitted to be used if they supply loads that do not exceed the ampacities specified in 402.5 and are installed in a raceway, an approved enclosure, or a listed cable.

(b) Conductors that are 14 AWG copper-clad aluminum shall be permitted to be used in Type MC cable and Type TC cable. The continuous load shall not exceed 8 amperes.

(c) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall not supply loads greater than the ampacities specified in 310.14.

(d) Flexible cords shall comply with the applicable general requirements, applications, and construction specifications for flexible cords and flexible cables in accordance with Article 400 Parts I and II.

(2) Insulation.

(a) Insulation on conductors shall be rated for the system voltage and not less than 600 volts.

(b) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall comply with the applicable general requirements for conductors rated up to and including 2000 volt for type designations, insulations, markings, ampacity ratings, and uses in accordance with 310.3, 310.4, 310.6, 310.8, 310.10, and 310.14.

(c) Conductors that are 18 AWG copper, 16 AWG copper, or 14 AWG copper-clad aluminum shall be Type FFH-2, Type KF-2, Type KFF-2, Type PAF, Type PAFF, Type PF, Type PFF, Type PGF, Type PGFF, Type PTF, Type PTFF, Type RFH-2, Type RFHH-2, Type RFHH-3, Type SF-2, SFF-2, Type TF, Type TFF, Type TFFN, Type TFN, Type ZF, or Type ZFF.

(d) Conductors with other types and thicknesses of insulation shall be permitted if listed for Class 1 circuit use.

(3) Overcurrent Protection.

(a) Overcurrent protection for conductors 14 AWG copper and larger shall be provided in accordance with the conductor ampacity, without applying the ampacity adjustment and correction factors specified in 310.15 to the ampacity calculation.

(b) Overcurrent protection shall not exceed 7 amperes for 18 AWG copper conductors and 10 amperes for 16 AWG copper and 14 AWG copper-clad aluminum.

Exception: The overcurrent protection specified in 300.26(C)(3)(1) and 300.26(C)(3)(2) shall not be required where this Code requires or permits other overcurrent protection ratings.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

M12027Text Modification

Tentative Interim Amendment

NFPA® 70®

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Reference: Table C.18, Table C.19 and Table C.20
TIA 23-7
(SC 22-12-7 / TIA Log #1678)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 8, and the NEC Correlating Committee, and was issued by the Standards Council on December 8, 2022, with an effective date of December 28, 2022.

*1. Revise Table Headers **only** for Table C.18, Table, C.19 and Table C.20 to read as follows:*

Table C.18 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.19 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.20 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

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Mod_12027_Text_TIA 23-7.pdf

Issue Date: December 8, 2022

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(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

M12027Text Modification

Tentative Interim Amendment

NFPA® 70®

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2023 Edition

Reference: 555.35
TIA 23-6
(SC 22-8-23 / TIA Log #1660)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.35 to read as follows:

555.35 Ground-Fault Protection of Equipment (GFPE) and Ground-Fault Circuit Interrupter. For other than floating buildings, ground-fault protection for docking facilities shall be provided in accordance with 555.35(A) through (~~F~~D).

~~**(A) Sources Directly Supplying Docking Facilities or Wharfs.** Listed GFPE, rated not more than 100 milliamperes, shall be provided for sources directly supplying all docking facilities or wharfs. Coordination with downstream GFPE shall be permitted.~~

(~~B~~A) Feeder. …

Exception: Transformer secondary conductors of a separately derived system that do not exceed 3 m (10 ft) and are installed in a raceway shall be permitted to be installed without ground-fault protection. This exception shall also apply to the supply terminals of the equipment supplied by the transformer secondary conductors.

(~~C~~B) Branch-Circuits.

(1) Receptacles Providing Shore Power. …

(2) Outlets for Other than Shore Power. Outlets supplied by branch circuits not exceeding 150 volts to ground and 60 amperes, single phase, and 150 volts or less to ground, 100 amperes or less, three phase, shall be provided with GFCI protection for personnel.

Exception to (~~C~~B): Low-voltage circuits not requiring grounding, not exceeding the low-voltage contact limit and supplied by listed transformers or power supplies that comply with 680.23(A)(2) shall be permitted to be installed without ground-fault protection.

(~~D~~C) Boat Hoists. …

(~~E~~D) Leakage Current Measurement Device. …

Informational Note No. 1: …

Informational Note No. 2: …

Exception: Where the shore power equipment includes a leakage indicator and leakage alarm, a separate leakage test device shall not be required.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Tentative Interim Amendment

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Reference: 555.30
TIA 23-5
(SC 22-8-22 / TIA Log #1659)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.30 to read as follows:

555.30 Electrical Equipment and Connections.

(A) General. All electrical components within electrical equipment (excluding wiring methods) and connections not intended for operation while submerged shall be located at least 305 mm (12 in.) above the deck of a fixed or floating structure, but not below the electrical datum plane. Conductor splices, within junction boxes identified for wet locations, utilizing sealed wire connector systems listed and identified for submersion shall be required for floating structures where located above the waterline but below the electrical datum plane.

(B) Replacements. …

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Mod_12027_Text_TIA 23-5.pdf Page: 1

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Tentative Interim Amendment

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Reference: 215.15
TIA 23-4
(SC 22-8-18 / TIA Log #1655)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 215.15 to read as follows:

215.15 Barriers. Barriers shall be placed such that no energized, uninsulated, ungrounded busbar or terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations in panelboards, switchboards, switchgear, or motor control centers supplied by feeder taps in 240.21(B) or transformer secondary conductors in 240.21(C) when the disconnecting device, to which the tap conductors are terminated, is in the open position.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 210.8(F) and Exception No. 2(new)
TIA 23-3
(SC 22-8-17 / TIA Log #1654)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 210.8(F) to read as follows:

210.8(F) Outdoor Outlets.
For dwellings, all outdoor outlets, other than those covered in 210.8(A), Exception No. 1, including outlets installed in the following locations, and supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, shall be provided with GFCI protection:

(1) Garages that have floors located at or below grade level
(2) Accessory buildings
(3) Boathouses

If equipment supplied by an outlet covered under the requirements of this section is replaced, the outlet shall be supplied with GFCI protection.

Exception No. 1: GFCI protection shall not be required on lighting outlets other than those covered in 210.8(C).
Exception No. 2: GFCI protection shall not be required for listed HVAC equipment. This exception shall expire September 1, 2026.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

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Reference: Article 100 (Ignitible Fibers/Flyings), 506.5, and 506.9(B)
TIA 23-2
(SC 22-4-8 / TIA Log #1617)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise Article 100 Ignitible Fibers/Flyings to read as follows:

Ignitible Fibers/Flyings. Fibers/flyings where any dimension is greater than 500 µm in nominal size, which are not likely to be in suspension in quantities to produce an explosible mixture, but could produce an ignitible layer fire hazard. [**499:**3.3.4.2]

Informational Note No.1: This definition and Informational Note No. 2 have been extracted from NFPA 499-2021, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.* The NFPA 499 reference is in brackets. Only editorial changes were made to the extracted text to make it consistent with this *Code.*

Informational Note No. 2: Section 500.5 of this *Code* prescribes a Class III location as one where ignitible fibers/flyings are present, but not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. This description addresses fibers/flyings that do not present a flash-fire hazard or explosion hazard by test. This could be because those fibers/flyings are too large or too agglomerated to be suspended in air in sufficient concentration, or at all, under typical test conditions. Alternatively, this could be because they burn so slowly that, when suspended in air, they do not propagate combustion at any concentration. In this document the zone classification system includes ignitible fibers/flyings as a fire hazard in a layer, which is not addressed in the IEC zone system (see IEC 60079-10-2, *Explosive atmospheres — Part 10-2: Classification of areas — Explosive dust atmospheres*). Where these are present, the user could also consider installation in accordance with Article 503 of this *Code.* [**499:**A.3.3.4.2]

2. Revise Section 506.5 to read as follows:

506.5 Classification of Locations.

(A) Classifications of Locations. …

(B) Zone 20, Zone 21, and Zone 22 Locations. …

(1) Zone 20. A Zone 20 location is a location where one of the following apply:

(1) Ignitible concentrations of combustible dust, ~~or~~ combustible fibers/flyings, or ignitible fibers/flyings are present continuously or for long periods of time.

…

(2) Zone 21. …

(3) Zone 22. A Zone 22 location is a location where one of the following apply:

(1) …

(2) Combustible dust, combustible fibers/flyings, or ignitible fibers/flyings are handled, processed, or used…

(3) …

3. Revise Section 506.9(B) to read as follows:

506.9 Equipment Requirements.

…

(B) Listing. Equipment that is listed for Zone 20 shall be permitted in a Zone 21 or Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying. Equipment that is listed for Zone 21 ~~can be used~~ shall be permitted in a Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying.

Issue Date: April 12, 2022

Effective Date: May 2, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo**)**

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 680.43, Exception No. 3
TIA 23-16
(SC 24-12-6 / TIA Log #1800)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17, and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on December 4, 2024, with an effective date of December 24, 2024.

1. Delete Exception No. 3 of 680.43 as follows:

680.43 Indoor Installations. A spa or hot tub installed indoors shall comply with the provisions of Parts I and II of this article except as modified by this section and shall be connected by the wiring methods of Chapter 3.

Exception No. 1: Listed spa and hot tub …

Exception No. 2: The equipotential bonding …

~~*Exception No. 3: For a dwelling unit(s) only, where a listed spa or hot tub is installed indoors, the wiring method requirements of 680.42(C) shall also apply.*~~

Issue Date: December 4, 2024

Effective Date: December 24, 2024

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

M12027Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 210.70
TIA 23-15
(SC 23-11-10/ TIA Log #1753)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 2, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 210.70 to read as follows:

210.70 Lighting Outlets Required. Lighting outlets shall be installed where specified in 210.70(A), (B), and (C). The switch or listed wall-mounted control device shall not rely exclusively on ~~a~~ battery power unless ~~a~~ it incorporates a positive means of notification of impending battery depletion. ~~is provided for automatically energizing the lighting outlets upon battery failure.~~

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Tentative Interim Amendment

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Reference: 517.30(B)(3)(a)
TIA 23-14
(SC 23-11-9 / TIA Log #1752)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by the NEC Code-Making Panel 15, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 517.30(B)(3)(a) to read as follows:

517.30(B)(3) Fuel Cell Systems. Fuel cell systems shall be permitted to serve as the alternate power source for all or part of an EES. [**99:**6.7.1.5.1]

(a) Installation of fuel cells shall comply with the requirements in Parts I through VI ~~VII~~ of Article 692 ~~for 1000 volts or less and Part VIII for over 1000 volts~~.

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Tentative Interim Amendment

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Reference: 400.47
TIA 23-13
(SC 23-8-57 / TIA Log #1731)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by Code-Making Panel 6 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise section 400.47 to read as follows:

400.47. ~~Minimum~~ Conductor Bending ~~Radii~~ Radius. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 2000 volts to 5000 volts shall not ~~exceed~~ be bent to a radius less than six times the overall cable outer diameter. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 5001 volts to 25,000 volts shall not ~~exceed~~ be bent to a radius less than eight times the overall cable outer diameter.

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Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Mod_12027_Text_TIA 23-13.pdf

M12027Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 408.6
TIA 23-12
(SC 23-8-56 / TIA Log #1699)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by Code-Making Panel 9 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 408.6 to read as follows:

408.6 Short-Circuit Current Rating. Switchboards, switchgear, and panelboards shall have a short-circuit current rating not less than the available fault current. In other than one- and two-family dwelling units, the available fault current and the date the calculation was performed shall be field marked on the enclosure at the point of supply. The marking shall be of sufficient durability to withstand the environment involved. ~~comply with 110.21(B)(3).~~

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Mod_12027_Text_TIA 23-12.pdf

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

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2023 Edition

Reference: 700.32(C), 701.32(C), and 708.54(C)
TIA 23-11
(SC 23-8-54 / TIA Log #1692)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by Code-Making Panel 13 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 700.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

700.32 Selective Coordination.

700.32(A) General. Emergency system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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

700.32(B) Replacements. Where emergency system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

700.32(C) Modifications. If modifications, additions, or deletions to the emergency system(s) occur, selective coordination of the emergency system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 700.32~~(C)~~ for an example of how emergency system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.~~

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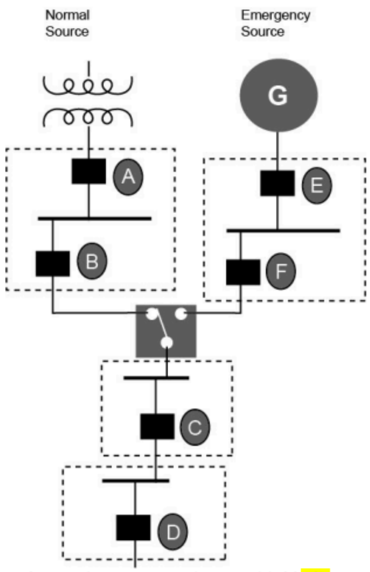

Informational Note Figure 700.32~~(C)~~ Emergency System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.

2. Revise 701.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

701.32 Selective Coordination.

701.32(A) General. Legally required standby system(s) overcurrent protective devices (OCPDs shall be selectively coordinated with all supply-side and load-side OCPDs.

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

701.32(B) Replacements. Where legally required standby OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

701.32(C) Modifications. If modifications, additions, or deletions to the legally required standby system(s) occur, selective coordination of the legally required system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 701.32~~(C)~~ for an example of how legally required standby system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.~~

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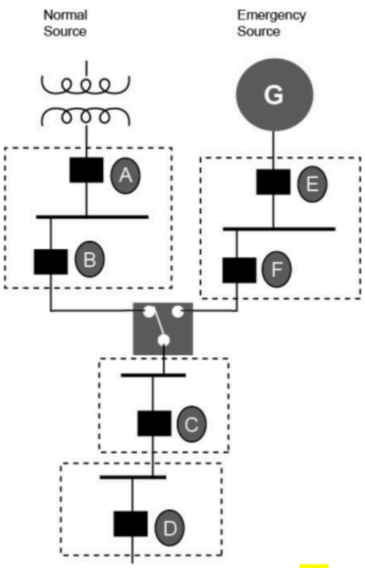


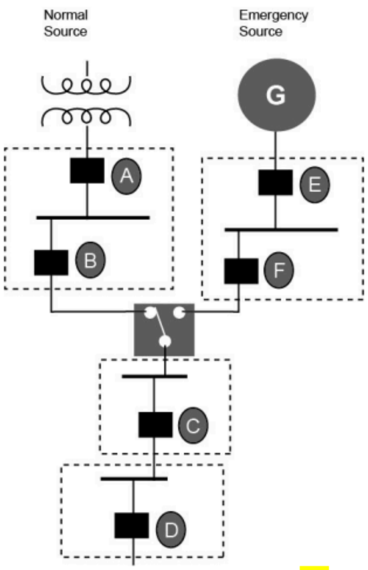
Informational Note Figure 701.32~~(C)~~ Legally Required Standby System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.

3. *Revise 708.54(C) Informational Note and title of Figure for the Informational Note to read as follows:*

708.54(A) General. Critical operations power system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.
Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.
708.54(B) Replacements. Where critical operations power system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.
708.54(C) Modifications. If modifications, additions, or deletions to the critical operations power system(s) occur, selective coordination of the critical operations power system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.
Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.

Informational Note: See Informational Note Figure 708.54~~(C)~~ for an example of how critical operations power system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.~~



Informational Note Figure 708.54~~(C)~~ Critical Operations Power System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.

Issue Date: August 25, 2023

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(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

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2023 Edition

Reference: 314.29(A)
TIA 23-10
(SC 23-3-10 / TIA Log #1690)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 9 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 314.29(A) to read as follows:

314.29 Boxes, Conduit Bodies, and Handhole Enclosures to Be Accessible. Boxes, conduit bodies, and handhole enclosures shall be installed so that wiring and devices contained in the boxes, conduit bodies, or handhole enclosures can be rendered accessible in accordance with 314.29(A) and (B).

(A) In Buildings and Other Structures. Boxes and conduit bodies shall be installed so the contained wiring and devices are accessible. Boxes and conduit bodies that are recessed into or behind finished surfaces of buildings shall have access to their internal contents maintained by openings in their covers and in the building finish that comply with 314.29(A)(1), (A)(2), or (A)(3) as applicable. Removable finished covers and faceplates that maintain this access shall be permitted.

(1) Boxes 1650 cm^3 (100 $in.^3$) or Less in Size. The openings in the building surfaces, if reduced from the outer walls of the box, shall be centered not more than 25 mm (1 in.) from the centerline of the box, and shall not extend beyond the walls of the box. If rectangular, the opening shall be not less than 73 mm (2 7/8 in.) by 45 mm (1 3/4 in.) in size. If circular, the opening shall not be less than 90 mm (3½ in.) in diameter.

Exception: Smaller openings in building surfaces that accommodate one or more individual devices shall be permitted if all of the following conditions are met:

1. *The outlet box that supplies the device(s) is nonmetallic.*
2. *The branch circuit wiring that supplies each device consists of a separate nonmetallic cable assembly originating outside the box, or individual sets of conductors in a single nonmetallic raceway, all of which originate outside the box. Other than the connections to a single device, these conductors are not spliced in the box or continued to another device, and no other wiring or raceways enter the box.*
3. *Each device is capable of removal from the building surface opening without being damaged. If a special tool is required for this purpose, the applicable circuit directory for the device records the location of the tool, together with a product code/QR code for acquiring a replacement if necessary.*
4. *All connections for each device to the branch circuit wiring are made with listed clamping-type wire connectors, which are supplied with the devices. The branch-circuit conductors are arranged to permit the connector(s) to be exposed after the device has been fully removed.*
5. *The device assemblies are listed for this application.*

(2) Boxes Larger Than 1650 cm^3 (100 $in.^3$) in Size. The openings shall not be smaller than the outer walls of the box.
(3) Conduit Bodies. The openings shall not be smaller than outer walls of the conduit body.
(B) Underground. Underground boxes and handhole enclosures shall be installed …

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

M12027Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 250.114(3)e and 250.114(4)e
TIA 23-1
(SC 21-12-13 / TIA Log #1608)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise 250.114(3)e and (4)e to read as follows:

250.114 Equipment Connected by Cord and Plug. Exposed, normally non-current-carrying metal parts of cord-and-plug-connected equipment shall be connected to the equipment grounding conductor under any of the following conditions:

…

(3) In residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

(4) In other than residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

…

Issue Date: December 8, 2021

Effective Date: December 28, 2021

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Plumbing

P12029

18

Date Submitted	02/11/2025	**Section**	102.4	**Proponent**	Bryan Holland
Chapter	1	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

A related modification has been submitted to the FBC-B, FBC-R, FBC-EC, FBC-EB, FBC-M, and FBC-FG to update the reference to NFPA 70-23, including all published TIAs.

Summary of Modification

This proposed modification recommends adoption of NFPA 70-23, including all published Tentative Interim Amendments (TIAs) in Chapter 15. (Chapter 15 is not in the drop box above)

Rationale

This proposed modification recommends updating the adopted edition of NFPA 70 to the 2023 edition, including all published TIAs (TIA 23-1 through TIA 23-16). Tentative Interim Amendments (TIAs) are important revisions to the code that have been issued by the NFPA Standards Council after publication of the document. All issued TIAs have been reviewed and approved through consensus voting on the basis of "technical merit" and "emergency nature" by the corresponding Code Making Panel, without creating a correlation issue with any other sections of the code. For the 2023 edition of NFPA 70, TIAs 23-1 through 23-6 were issued prior to publication of the code and incorporated into the first printing. This proposed modification recommends all TIAs, 23-1 through 23-16 be officially adopted and incorporated into the code. This will help reduce conflicts in the field and improve consistent enforcement across all Florida jurisdictions.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

This proposed modification will improve the consistent enforcement of the code by the local entity.

Impact to building and property owners relative to cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Impact to industry relative to the cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Impact to small business relative to the cost of compliance with code

This proposed modification will not change the cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The changes made to the 2023 NEC along with all issued TIAs represent important improvements and corrections to the published code. All (16) TIAs have been deemed to have both technical merit and emergency in nature, thus increasing the health, safety, and welfare of the general public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification improves the code by updating to the most current edition of the NEC and by incorporating corrections made after initial publication.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

This proposed modification improves the effectiveness of the code.

P12029Text Modification

Chapter 15 Referenced Standards

NFPA

70 - ~~20~~ 23 National Electrical Code (NEC), including all published Tentative Interim Amendments (TIAs) published until December 4, 2024

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Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Definition of Pool, and 680.26
TIA 23-9
(SC 23-3-8 / TIA Log #1687)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise the definition of "Pool" to read as follows:

Pool. Manufactured or field-constructed equipment designed to contain water on a permanent or semipermanent basis and used by persons for swimming, wading, immersion, or therapeutic purposes, but not including bodies of water incorporated as part of an industrial process or lakes, lagoons, surf parks, or other natural and man-made bodies of water that may incorporate swimming and swimming areas. (680) (CMP-17)

Informational Note: Natural and man-made bodies of water, which includes lakes, lagoons, surf parks, or other similar bodies of water, are addressed in Article 682.

2. Revise section paragraph 680.26 to read as follows:

680.26 Equipotential Bonding.

(A) Performance. The equipotential bonding required by 680.26(B) and (C) to reduce voltage gradients in the pool area shall be installed for pools with or without associated electrical equipment related to the pool.

Informational Note No. 1: Some causes of voltage gradients originate outside the premises wiring system and are not within the scope of the *NEC*. Measures identified in Rule 097D2 of ANSI C2, *National Electrical Safety Code,* can also serve to address voltage gradients originating on the utility side of the service point.

Informational Note No. 2: By its nature, equipotential bonding of swimming pools and perimeter surfaces involves contact between various metallic materials and the earth. This can, in some cases, expose various specific metals to a corrosive environment, depending on factors such as the type and chemical content of the soil and the specific metal. Corrosive environments are also addressed in 680.14.

(B) Bonded Parts. …

(1) Conductive Pool Shells. …

(2) Perimeter Surfaces. The perimeter surface to be bonded shall be considered to extend for ~~1 m~~ 900 mm (3 ft) horizontally beyond the inside walls of the pool ~~and~~ while also at a height between 900 mm (3 ft) above and 600 mm (2 ft) below the maximum water level. The perimeter surface shall include unpaved surfaces, concrete, and other types of paving. Perimeter surfaces separated from the pool by a permanent wall or building 1.5 m (5 ft) in height or more shall

require equipotential bonding only on the pool side of the permanent wall or building. Bonding to perimeter surfaces shall be provided as specified in 680.26(B)(2)(a), (B)(2)(b), ~~or~~ (B)(2)(c), and (B)(2)(d). ~~and~~ For conductive pool shells where bonding to perimeter surfaces is required, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four points uniformly spaced around the perimeter of the pool, or if the bonded perimeter surface does not surround the entire pool, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four uniformly spaced points along the bonded perimeter surface. For nonconductive pool shells where bonding to the perimeter surfaces is required, bonding at four points shall not be required, and the perimeter bonding shall be attached to the 8 AWG copper equipotential bonding conductor and, if present, to any conductive support structure for the pool.

Informational Note: Because the perimeter surface can incorporate various types of materials at various locations and elevations above and below maximum water level, the perimeter surface required to be bonded might not surround the entire pool. The 8 AWG copper equipotential bonding conductor can encircle the entire pool to facilitate connection of bonded parts.

(a) ~~*Structural Reinforcing Steel.* Structural reinforcing steel shall be bonded in accordance with 680.26(B)(1)(a).~~ *Conductive Paved Portions of Perimeter Surfaces.* Conductive paved portions of perimeter surfaces, including masonry pavers, if used, shall be bonded with unencapsulated structural reinforcing steel in accordance with 680.26(B)(1)(a), or with unencapsulated steel structural welded wire reinforcement (welded wire mesh, welded wire fabric), bonded together by steel tie wires or the equivalent. Steel welded wire reinforcement shall be fully embedded within the pavement unless the pavement will not allow for embedding. If the reinforcing steel is absent, or is encapsulated in a nonconductive compound, or embedding is not possible, unencapsulated welded wire steel reinforcement or a copper conductor grid shall be provided and shall be secured directly under the paving, and not more than 150 mm (6 in.) below finished grade.

Unencapsulated steel welded wire reinforcement that is not fully embedded in concrete, and copper grid regardless of location, where used for equipotential bonding, shall be listed for corrosion resistance and mechanical performance. This listing requirement shall become effective January 1, 2025. The copper grid or unencapsulated steel welded wire reinforcement shall also meet the following:

(1) Copper grid is constructed of 8 AWG solid bare copper and arranged in accordance with 680.26(B)(1)(b)(3).
(2) Steel welded wire reinforcement is minimum ASTM 6x6-W2.0 x W2.0 or minimum No. 3 rebar constructed in a 300 mm (12 in.) grid.
(3) Copper grid and steel welded wire reinforcement follow the contour of the perimeter surface extending not less than 900 mm (3 ft) horizontally beyond the inside walls of the pool.
(4) Only listed splicing devices or exothermic welding are used.

Informational Note No. 1: Performance of the equipotential bonding system at the perimeter surface is improved as the distance between the bonding means and finished grade is minimized, either by embedding within, or by direct contact with the underside of, the finished pavement.

Informational Note No. 2: See ASTM A615/A615M, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement;* A1064/A1064M, *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete;* A1022/A1022M, *Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement;* A1060A/A1060M, *Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete;* and ACI Standard ACI 318, *Building Code Requirements for Structural Concrete*, for examples of standards currently used in the listing of reinforcing steel bars and steel welded wire reinforcement.

(b) *Unpaved Portions of Perimeter Surfaces.* Unpaved portions of perimeter surfaces shall be bonded with any of the following methods:
(1) ~~*Copper Ring.* Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, a~~ ~~c~~Copper conductor(s) shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. At least one minimum 8 AWG bare solid copper conductor, including the 8 AWG copper equipotential bonding conductor if available ~~shall be provided~~.
~~(2)~~b. The conductors ~~shall~~ follow the contour of the perimeter surface.
~~(3)~~c. Only listed splicing devices or exothermic welding are used. ~~shall be permitted.~~
~~(4)~~d. The ~~required~~ conductor(s) is ~~shall be~~ 450 mm to 600 mm (18 in. to 24 in.) from the inside walls of the pool.
~~(5)~~e. The ~~required~~ conductor(s) ~~shall be secured within or~~ is under the unpaved portion of the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.
f. Be installed only in perimeter surfaces not intended to have direct access to swimmers in the pool.

(~~c~~2) ~~*Copper Grid*. Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, c~~Copper grid or unencapsulated steel welded wire reinforcement used for equipotential bonding of unpaved portions of perimeter surfaces shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. ~~The copper grid shall be constructed of 8 AG solid bare copper and be arranged~~ Be installed in accordance with 680.26~~(B)(1)(b)(3)~~(B)(2)(a).
~~(2) The copper grid shall follow the contour of the perimeter surface extending 1 m (3 ft) horizontally beyond the inside walls of the pool.~~
~~(3) Only listed splicing devices or exothermic welding shall be permitted.~~
~~(4)~~b. ~~The copper grid shall be secured~~ Be located within ~~or under~~ the ~~deck or~~ unpaved surface(s) between 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.

(c) *Nonconductive Perimeter Surfaces.* Equipotential bonding shall not be required for nonconductive portions of perimeter surfaces that are separated from earth or raised on nonconducting supports, and it shall not be required for any perimeter surface that is electrically separated from the pool structure and raised on nonconductive supports above an equipotentially bonded surface.

Informational Note: Nonconductive materials include, but are not limited to, wood, plastic, wood-plastic composites, fiberglass, and fiberglass composites.

(d) *Interconnection of Bonded Portions of Perimeter Surfaces.* All surfaces where equipotential bonding is required shall be interconnected using listed splicing devices or exothermic welding. Where copper wire is used for this purpose, it shall be solid copper, not smaller than 8 AWG. The conductor shall be permitted to encircle the pool to facilitate bonding connections to portions of the perimeter covered in 680.26(B)(2)(a) and (B)(2)(b) that are not contiguous.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

P12029Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 300.26
TIA 23-8
(SC 23-3-9 / TIA Log #1688)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 3 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 300.26 to read as follows:

300.26 Remote-Control and Signaling Circuits Classification.
Remote-control and signaling circuits shall be classified as either power-limited or non-power-limited and comply with ~~the following~~300.26(A) through (C).

(~~1~~A) **Class 1 Power-Limited Remote-Control and Signaling Circuits**. Class 1 power-limited remote-control and signaling circuits shall comply with 724.3.

(~~2~~B) **Class 2 and Class 3 Power-Limited Remote-Control and Signaling Circuits**. Class 2 and Class 3 power-limited remote-control and signaling circuits shall comply with 725.3.

(~~3~~C) **Non-Power-Limited Remote-Control and Signaling Circuits**. Non-power-limited remote-control and signaling circuits shall be installed in accordance with 300.2 through 300.25 and comply with 300.26(C)(1) through (C)(3).

(1) Sizes and Use.

(a) Conductors that are 18 AWG and 16 AWG copper shall be permitted to be used if they supply loads that do not exceed the ampacities specified in 402.5 and are installed in a raceway, an approved enclosure, or a listed cable.

(b) Conductors that are 14 AWG copper-clad aluminum shall be permitted to be used in Type MC cable and Type TC cable. The continuous load shall not exceed 8 amperes.

(c) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall not supply loads greater than the ampacities specified in 310.14.

(d) Flexible cords shall comply with the applicable general requirements, applications, and construction specifications for flexible cords and flexible cables in accordance with Article 400 Parts I and II.

(2) Insulation.

(a) Insulation on conductors shall be rated for the system voltage and not less than 600 volts.

(b) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall comply with the applicable general requirements for conductors rated up to and including 2000 volt for type designations, insulations, markings, ampacity ratings, and uses in accordance with 310.3, 310.4, 310.6, 310.8, 310.10, and 310.14.

(c) Conductors that are 18 AWG copper, 16 AWG copper, or 14 AWG copper-clad aluminum shall be Type FFH-2, Type KF-2, Type KFF-2, Type PAF, Type PAFF, Type PF, Type PFF, Type PGF, Type PGFF, Type PTF, Type PTFF, Type RFH-2, Type RFHH-2, Type RFHH-3, Type SF-2, SFF-2, Type TF, Type TFF, Type TFFN, Type TFN, Type ZF, or Type ZFF.

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(d) Conductors with other types and thicknesses of insulation shall be permitted if listed for Class 1 circuit use.

(3) Overcurrent Protection.

(a) Overcurrent protection for conductors 14 AWG copper and larger shall be provided in accordance with the conductor ampacity, without applying the ampacity adjustment and correction factors specified in 310.15 to the ampacity calculation.

(b) Overcurrent protection shall not exceed 7 amperes for 18 AWG copper conductors and 10 amperes for 16 AWG copper and 14 AWG copper-clad aluminum.

Exception: The overcurrent protection specified in 300.26(C)(3)(1) and 300.26(C)(3)(2) shall not be required where this Code requires or permits other overcurrent protection ratings.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Table C.18, Table C.19 and Table C.20
TIA 23-7
(SC 22-12-7 / TIA Log #1678)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 8, and the NEC Correlating Committee, and was issued by the Standards Council on December 8, 2022, with an effective date of December 28, 2022.

1. Revise Table Headers ***only*** *for Table C.18, Table, C.19 and Table C.20 to read as follows:*

Table C.18 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.19 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.20 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Issue Date: December 8, 2022

Effective Date: December 28, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 555.35
TIA 23-6
(SC 22-8-23 / TIA Log #1660)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.35 to read as follows:

555.35 Ground-Fault Protection of Equipment (GFPE) and Ground-Fault Circuit Interrupter. For other than floating buildings, ground-fault protection for docking facilities shall be provided in accordance with 555.35(A) through (~~F~~D).

~~**(A) Sources Directly Supplying Docking Facilities or Wharfs.** Listed GFPE, rated not more than 100 milliamperes, shall be provided for sources directly supplying all docking facilities or wharfs. Coordination with downstream GFPE shall be permitted.~~

(~~B~~A) Feeder. …

Exception: Transformer secondary conductors of a separately derived system that do not exceed 3 m (10 ft) and are installed in a raceway shall be permitted to be installed without ground-fault protection. This exception shall also apply to the supply terminals of the equipment supplied by the transformer secondary conductors.

(~~C~~B) Branch-Circuits.

(1) Receptacles Providing Shore Power. …

(2) Outlets for Other than Shore Power. Outlets supplied by branch circuits not exceeding 150 volts to ground and 60 amperes, single phase, and 150 volts or less to ground, 100 amperes or less, three phase, shall be provided with GFCI protection for personnel.

Exception to (~~C~~B): Low-voltage circuits not requiring grounding, not exceeding the low-voltage contact limit and supplied by listed transformers or power supplies that comply with 680.23(A)(2) shall be permitted to be installed without ground-fault protection.

(~~D~~C) Boat Hoists. …

(~~E~~D) Leakage Current Measurement Device. …

Informational Note No. 1: …

Informational Note No. 2: …

Exception: Where the shore power equipment includes a leakage indicator and leakage alarm, a separate leakage test device shall not be required.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

P12029Text Modification

Tentative Interim Amendment

NFPA® 70®

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2023 Edition

Reference: 555.30
TIA 23-5
(SC 22-8-22 / TIA Log #1659)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.30 to read as follows:

555.30 Electrical Equipment and Connections.

(A) General. All electrical components within electrical equipment (excluding wiring methods) and connections not intended for operation while submerged shall be located at least 305 mm (12 in.) above the deck of a fixed or floating structure, but not below the electrical datum plane. Conductor splices, within junction boxes identified for wet locations, utilizing sealed wire connector systems listed and identified for submersion shall be required for floating structures where located above the waterline but below the electrical datum plane.

(B) Replacements. …

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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P12029Text Modification

Tentative Interim Amendment

NFPA® 70®

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2023 Edition

Reference: 215.15
TIA 23-4
(SC 22-8-18 / TIA Log #1655)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 215.15 to read as follows:

215.15 Barriers. Barriers shall be placed such that no energized, uninsulated, ungrounded busbar or terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations in panelboards, switchboards, switchgear, or motor control centers supplied by feeder taps in 240.21(B) or transformer secondary conductors in 240.21(C) when the disconnecting device, to which the tap conductors are terminated, is in the open position.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Tentative Interim Amendment

NFPA® 70®

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2023 Edition

Reference: 210.8(F) and Exception No. 2(new)
TIA 23-3
(SC 22-8-17 / TIA Log #1654)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 210.8(F) to read as follows:

210.8(F) Outdoor Outlets.
For dwellings, all outdoor outlets, other than those covered in 210.8(A), Exception No. 1, including outlets installed in the following locations, and supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, shall be provided with GFCI protection:

(1) Garages that have floors located at or below grade level
(2) Accessory buildings
(3) Boathouses

If equipment supplied by an outlet covered under the requirements of this section is replaced, the outlet shall be supplied with GFCI protection.

Exception No. 1: GFCI protection shall not be required on lighting outlets other than those covered in 210.8(C).
Exception No. 2: GFCI protection shall not be required for listed HVAC equipment. This exception shall expire September 1, 2026.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Article 100 (Ignitible Fibers/Flyings), 506.5, and 506.9(B)
TIA 23-2
(SC 22-4-8 / TIA Log #1617)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise Article 100 Ignitible Fibers/Flyings to read as follows:

Ignitible Fibers/Flyings. Fibers/flyings where any dimension is greater than 500 μm in nominal size, which are not likely to be in suspension in quantities to produce an explosible mixture, but could produce an ignitible layer fire hazard. [**499:**3.3.4.2]

Informational Note No.1: This definition and Informational Note No. 2 have been extracted from NFPA 499-2021, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.* The NFPA 499 reference is in brackets. Only editorial changes were made to the extracted text to make it consistent with this *Code.*

Informational Note No. 2: Section 500.5 of this *Code* prescribes a Class III location as one where ignitible fibers/flyings are present, but not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. This description addresses fibers/flyings that do not present a flash-fire hazard or explosion hazard by test. This could be because those fibers/flyings are too large or too agglomerated to be suspended in air in sufficient concentration, or at all, under typical test conditions. Alternatively, this could be because they burn so slowly that, when suspended in air, they do not propagate combustion at any concentration. In this document the zone classification system includes ignitible fibers/flyings as a fire hazard in a layer, which is not addressed in the IEC zone system (see IEC 60079-10-2, *Explosive atmospheres — Part 10-2: Classification of areas — Explosive dust atmospheres*). Where these are present, the user could also consider installation in accordance with Article 503 of this *Code.* [**499:**A.3.3.4.2]

2. Revise Section 506.5 to read as follows:

506.5 Classification of Locations.
(A) Classifications of Locations. …
(B) Zone 20, Zone 21, and Zone 22 Locations. …
(1) Zone 20. A Zone 20 location is a location where one of the following apply:
(1) Ignitible concentrations of combustible dust, ~~or~~ combustible fibers/flyings, or ignitible fibers/flyings are present continuously or for long periods of time.
…
(2) Zone 21. …
(3) Zone 22. A Zone 22 location is a location where one of the following apply:
(1) …
(2) Combustible dust, combustible fibers/flyings, or ignitible fibers/flyings are handled, processed, or used…
(3) …

3. Revise Section 506.9(B) to read as follows:

506.9 Equipment Requirements.
…

P12029Text Modification

(B) Listing. Equipment that is listed for Zone 20 shall be permitted in a Zone 21 or Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying. Equipment that is listed for Zone 21 ~~can be used~~ shall be permitted in a Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying.

Issue Date: April 12, 2022

Effective Date: May 2, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo**)**

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Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 680.43, Exception No. 3
TIA 23-16
(SC 24-12-6 / TIA Log #1800)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17, and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on December 4, 2024, with an effective date of December 24, 2024.

1. Delete Exception No. 3 of 680.43 as follows:

680.43 Indoor Installations. A spa or hot tub installed indoors shall comply with the provisions of Parts I and II of this article except as modified by this section and shall be connected by the wiring methods of Chapter 3.

Exception No. 1: Listed spa and hot tub …

Exception No. 2: The equipotential bonding …

~~*Exception No. 3: For a dwelling unit(s) only, where a listed spa or hot tub is installed indoors, the wiring method requirements of 680.42(C) shall also apply.*~~

Issue Date: December 4, 2024

Effective Date: December 24, 2024

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

P12029Text Modification

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 210.70
TIA 23-15
(SC 23-11-10/ TIA Log #1753)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 2, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 210.70 to read as follows:

210.70 Lighting Outlets Required. Lighting outlets shall be installed where specified in 210.70(A), (B), and (C). The switch or listed wall-mounted control device shall not rely exclusively on ~~a~~ battery power unless ~~a~~ it incorporates a positive means of notification of impending battery depletion. ~~is provided for automatically energizing the lighting outlets upon battery failure.~~

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Page: 1

Mod_12029_Text_TIA 23-15.pdf

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 517.30(B)(3)(a)
TIA 23-14
(SC 23-11-9 / TIA Log #1752)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 15, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 517.30(B)(3)(a) to read as follows:

517.30(B)(3) Fuel Cell Systems. Fuel cell systems shall be permitted to serve as the alternate power source for all or part of an EES. [**99:**6.7.1.5.1]

(a) Installation of fuel cells shall comply with the requirements in Parts I through VI ~~VII~~ of Article 692 ~~for 1000 volts or less and Part VIII for over 1000 volts~~.

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 400.47
TIA 23-13
(SC 23-8-57 / TIA Log #1731)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by Code-Making Panel 6 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise section 400.47 to read as follows:

400.47. ~~Minimum~~ Conductor Bending ~~Radii~~ Radius. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 2000 volts to 5000 volts shall not ~~exceed~~ be bent to a radius less than six times the overall cable outer diameter. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 5001 volts to 25,000 volts shall not ~~exceed~~ be bent to a radius less than eight times the overall cable outer diameter.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 408.6
TIA 23-12
(SC 23-8-56 / TIA Log #1699)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by Code-Making Panel 9 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 408.6 to read as follows:

408.6 Short-Circuit Current Rating. Switchboards, switchgear, and panelboards shall have a short-circuit current rating not less than the available fault current. In other than one- and two-family dwelling units, the available fault current and the date the calculation was performed shall be field marked on the enclosure at the point of supply. The marking shall be of sufficient durability to withstand the environment involved. ~~comply with 110.21(B)(3).~~

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 700.32(C), 701.32(C), and 708.54(C)
TIA 23-11
(SC 23-8-54 / TIA Log #1692)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by Code-Making Panel 13 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 700.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

700.32 Selective Coordination.

700.32(A) General. Emergency system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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

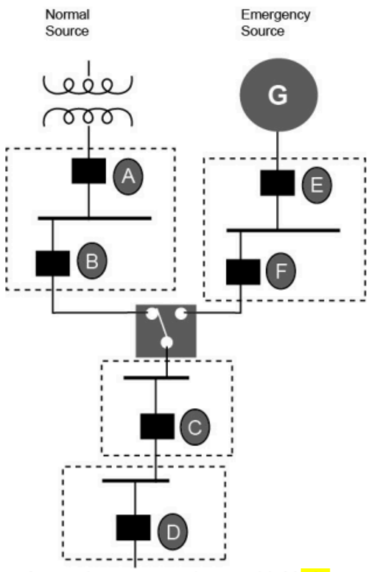
700.32(B) Replacements. Where emergency system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

700.32(C) Modifications. If modifications, additions, or deletions to the emergency system(s) occur, selective coordination of the emergency system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 700.32~~(C)~~ for an example of how emergency system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.~~



Informational Note Figure 700.32~~(C)~~ Emergency System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.

2. Revise 701.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

701.32 Selective Coordination.

701.32(A) General. Legally required standby system(s) overcurrent protective devices (OCPDs shall be selectively coordinated with all supply-side and load-side OCPDs.

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

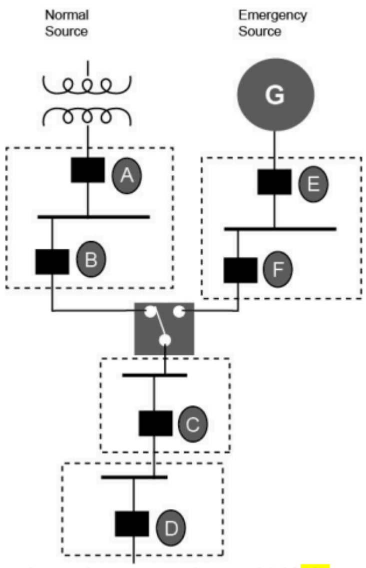
701.32(B) Replacements. Where legally required standby OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

701.32(C) Modifications. If modifications, additions, or deletions to the legally required standby system(s) occur, selective coordination of the legally required system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 701.32~~(C)~~ for an example of how legally required standby system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.~~



Informational Note Figure 701.32~~(C)~~ Legally Required Standby System Selective Coordination.
<u>OCPD D selectively coordinates with OCPDs C, F, E, B, and A.</u>
<u>OCPD C selectively coordinates with OCPDs F, E, B, and A.</u>
<u>OCPD F selectively coordinates with OCPD E.</u>
<u>OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.</u>

3. *Revise 708.54(C) Informational Note and title of Figure for the Informational Note to read as follows:*

708.54(A) General. Critical operations power system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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

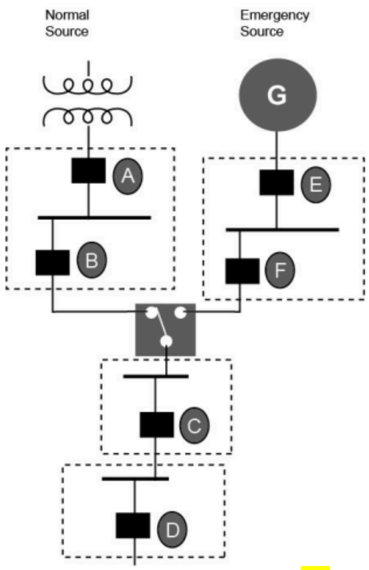
708.54(B) Replacements. Where critical operations power system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

708.54(C) Modifications. If modifications, additions, or deletions to the critical operations power system(s) occur, selective coordination of the critical operations power system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 708.54~~(C)~~ for an example of how critical operations power system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.~~



Informational Note Figure 708.54~~(C)~~ Critical Operations Power System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 314.29(A)
TIA 23-10
(SC 23-3-10 / TIA Log #1690)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 9 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 314.29(A) to read as follows:

314.29 Boxes, Conduit Bodies, and Handhole Enclosures to Be Accessible. Boxes, conduit bodies, and handhole enclosures shall be installed so that wiring and devices contained in the boxes, conduit bodies, or handhole enclosures can be rendered accessible in accordance with 314.29(A) and (B).

(A) In Buildings and Other Structures. Boxes and conduit bodies shall be installed so the contained wiring and devices are accessible. Boxes and conduit bodies that are recessed into or behind finished surfaces of buildings shall have access to their internal contents maintained by openings in their covers and in the building finish that comply with 314.29(A)(1), (A)(2), or (A)(3) as applicable. Removable finished covers and faceplates that maintain this access shall be permitted.

(1) Boxes 1650 cm³ (100 in.³) or Less in Size. The openings in the building surfaces, if reduced from the outer walls of the box, shall be centered not more than 25 mm (1 in.) from the centerline of the box, and shall not extend beyond the walls of the box. If rectangular, the opening shall be not less than 73 mm (2 7/8 in.) by 45 mm (1 3/4 in.) in size. If circular, the opening shall not be less than 90 mm (3½ in.) in diameter.

Exception: Smaller openings in building surfaces that accommodate one or more individual devices shall be permitted if all of the following conditions are met:

(1) The outlet box that supplies the device(s) is nonmetallic.
(2) The branch circuit wiring that supplies each device consists of a separate nonmetallic cable assembly originating outside the box, or individual sets of conductors in a single nonmetallic raceway, all of which originate outside the box. Other than the connections to a single device, these conductors are not spliced in the box or continued to another device, and no other wiring or raceways enter the box.
(3) Each device is capable of removal from the building surface opening without being damaged. If a special tool is required for this purpose, the applicable circuit directory for the device records the location of the tool, together with a product code/QR code for acquiring a replacement if necessary.
(4) All connections for each device to the branch circuit wiring are made with listed clamping-type wire connectors, which are supplied with the devices. The branch-circuit conductors are arranged to permit the connector(s) to be exposed after the device has been fully removed.
(5) The device assemblies are listed for this application.

(2) Boxes Larger Than 1650 cm³ (100 in.³) in Size. The openings shall not be smaller than the outer walls of the box.
(3) Conduit Bodies. The openings shall not be smaller than outer walls of the conduit body.
(B) Underground. Underground boxes and handhole enclosures shall be installed …

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 250.114(3)e and 250.114(4)e
TIA 23-1
(SC 21-12-13 / TIA Log #1608)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise 250.114(3)e and (4)e to read as follows:

250.114 Equipment Connected by Cord and Plug. Exposed, normally non-current-carrying metal parts of cord-and-plug-connected equipment shall be connected to the equipment grounding conductor under any of the following conditions:

…

(3) In residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

(4) In other than residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

…

Issue Date: December 8, 2021

Effective Date: December 28, 2021

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Residential

E12183

19

Date Submitted	02/16/2025	**Section**	301.2.1.1.1	**Proponent**	Joseph Belcher
Chapter	3	**Affects HVHZ**	Yes	**Attachments**	No
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

Summary of Modification

Electrical receptacles in Cat I and II sunrooms

Rationale

To incorporate the language of Declaratory Statement DCA09-DEC351 clarifying the code to incorporate the decision rendered by the Commission addressing the conflict between two referenced standards, thereby significantly reducing unnecessary costs, which do not add public safety. Builders frequently encounter ignorance of the existence of this Declaratory Statement, resulting in delays in the project while documentation is submitted for review and approval by the officials. In fact, one jurisdiction states the NEC prevails over the DS when the DS specifically addresses the conflict caused by the NEC. Category I and Category II Sunrooms are defined as nonhabitable and unconditioned. Since the DS is binding on all parties it should be incorporated into the code. The addition of electrical outlets can run from hundreds to thousands of dollars.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None. If anything a reduction in the cost of administration function time.

Impact to building and property owners relative to cost of compliance with code

A potential reduction in cost of hundreds to thousands of dollars

Impact to industry relative to the cost of compliance with code

A potential reduction in cost of hundreds to thousands of dollars

Impact to small business relative to the cost of compliance with code

A potential reduction in cost of hundreds to thousands of dollars

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Improves the welfare of the public by clarifying the code to incorporate the decision rendered by the Commission addressing the conflict between two referenced standards, thereby significantly reducing unnecessary costs, which do not add public safety.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Improves the code by incorporating the decision rendered by the Commission addressing the conflict between two referenced standards, thereby significantly reducing unnecessary costs, which do not add public safety.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The change does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

The proposed change does not degrade the effectiveness of the code and improves the effectiveness of the code.

E12183Text Modification

R301.2.2 Electrical Receptacles. Notwithstanding the NEC, receptacles shall not be required in Category I or Category II Sunrooms.

Page: 1

Mod12183_TextOfModification.pdf

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Residential

E12048

20

Date Submitted	02/12/2025	**Section**	3408.1	**Proponent**	Bryan Holland
Chapter	34	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

N/A

Summary of Modification

Deletes an unnecessary amendment to the NEC that is adequately addressed in the 2023 edition.

Rationale

This proposed modification recommends Section E3408.1 of the FBC-R that amended 210.8(F) of the 2020 NEC be completely deleted from the code. 210.8(F) of the 2023 NEC includes several important improvements. The rule now also applies to garages that have floors located at or below grade level, accessory buildings, and boathouses located at dwellings. Additionally, a new requirement has been added stating that when equipment supplied by an outlet covered under the requirements of this section is replaced, the outlet shall be supplied with GFCI protection. Fortunately, there are no TIAs to the 2023 edition that has modified this section.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

This proposed modification has little to no impact on the local entity relative to enforcement of the code.

Impact to building and property owners relative to cost of compliance with code

This proposed modification has no impact on cost of compliance with code.

Impact to industry relative to the cost of compliance with code

This proposed modification has no impact on cost of compliance with code.

Impact to small business relative to the cost of compliance with code

This proposed modification has no impact on cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposed modification improves health, safety, and welfare of the general public by ensure GFCI protection is provided where the risk of shock is greatest.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification both strengthens and improves the code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

This proposed modification improves the effectiveness of the code.

E12048Text Modification

~~**SECTION E3408**~~
~~**GFCI PROTECTION**~~

~~**E3408.1.**~~

~~NFPA 70-20: *National Electric Code*, Article 210 (Branch Circuits), Section 210.8, Ground-Fault Circuit-Interrupter Protection for Personnel, is amended to read as follows:~~

~~**210.8 Ground-Fault Circuit-Interrupter Protection for Personnel.** Ground-fault circuit-interrupter protection for personnel shall be provided as required in 210.8(A) through (F). The ground-fault circuit-interrupter shall be installed in a readily accessible location.~~

~~Items (A) through (E) unchanged.~~

~~**(F) Outdoor Outlets.** All outdoor outlets for dwellings, other than those covered in 210.8(A)(3), Exception to (3) that are supplied by single-phase branch circuits rated 150 volts to ground or less, 50 amperes or less, shall have ground-fault circuit-interrupter protection for personnel.~~

> ~~**Exception No. 1:** Ground-fault circuit-interrupter protection shall not be required on lighting outlets other than those covered in 210.8(C).~~
>
> ~~**Exception No. 2:** GFCI protection shall not be required for listed and labeled HVAC equipment.~~
>
> ~~*Informational Note: See UL 60335-2-40, Household And Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers or* UL 1995, *Heating and Cooling Equipment for product safety standards.(1)*~~

Page: 1

Mod12048_TextOfModification.pdf

TAC: Electrical

Total Mods for **Electrical** in **Pending Review : 21**

Total Mods for report: 21

Sub Code: Residential

E11955

21

Date Submitted	02/10/2025	**Section**	102.4	**Proponent**	Bryan Holland
Chapter	2712	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Pending Review				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language No**

Related Modifications

A related modification has been submitted to the FBC-B to update the reference to NFPA 70-23, including all published TIAs.

Summary of Modification

This proposed modification recommends adoption of NFPA 70-23, including all published Tentative Interim Amendments (TIAs).

Rationale

This proposed modification recommends updating the adopted edition of NFPA 70 to the 2023 edition, including all published TIAs (TIA 23-1 through TIA 23-16). Tentative Interim Amendments (TIAs) are important revisions to the code that have been issued by the NFPA Standards Council after publication of the document. All issued TIAs have been reviewed and approved through consensus voting on the basis of "technical merit" and "emergency nature" by the corresponding Code Making Panel, without creating a correlation issue with any other sections of the code. For the 2023 edition of NFPA 70, TIAs 23-1 through 23-6 were issued prior to publication of the code and incorporated into the first printing. This proposed modification recommends all TIAs, 23-1 through 23-16 be officially adopted and incorporated into the code. This will help reduce conflicts in the field and improve consistent enforcement across all Florida jurisdictions.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
This proposed modification will improve the consistent enforcement of the code by the local entity.

Impact to building and property owners relative to cost of compliance with code
This proposed modification will not change the cost of compliance with code.

Impact to industry relative to the cost of compliance with code
This proposed modification will not change the cost of compliance with code.

Impact to small business relative to the cost of compliance with code
This proposed modification will not change the cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The changes made to the 2023 NEC along with all issued TIAs represent important improvements and corrections to the published code. All (16) TIAs have been deemed to have both technical merit and emergency in nature, thus increasing the health, safety, and welfare of the general public.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification improves the code by updating to the most current edition of the NEC and by incorporating corrections made after initial publication.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction.

Does not degrade the effectiveness of the code

This proposed modification improves the effectiveness of the code.

CHAPTER 46 REFERENCED STANDARDS

NFPA

70 - ~~20~~ 23 National Electrical Code (NEC), including all published Tentative Interim Amendments (TIAs) published until December 4, 2024

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: Definition of Pool, and 680.26
TIA 23-9
(SC 23-3-8 / TIA Log #1687)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise the definition of "Pool" to read as follows:

Pool. Manufactured or field-constructed equipment designed to contain water on a permanent or semipermanent basis and used by persons for swimming, wading, immersion, or therapeutic purposes, but not including bodies of water incorporated as part of an industrial process or lakes, lagoons, surf parks, or other natural and man-made bodies of water that may incorporate swimming and swimming areas. (680) (CMP-17)

Informational Note: Natural and man-made bodies of water, which includes lakes, lagoons, surf parks, or other similar bodies of water, are addressed in Article 682.

2. Revise section paragraph 680.26 to read as follows:

680.26 Equipotential Bonding.

(A) Performance. The equipotential bonding required by 680.26(B) and (C) to reduce voltage gradients in the pool area shall be installed for pools with or without associated electrical equipment related to the pool.

Informational Note No. 1: Some causes of voltage gradients originate outside the premises wiring system and are not within the scope of the *NEC*. Measures identified in Rule 097D2 of ANSI C2, *National Electrical Safety Code*, can also serve to address voltage gradients originating on the utility side of the service point.

Informational Note No. 2: By its nature, equipotential bonding of swimming pools and perimeter surfaces involves contact between various metallic materials and the earth. This can, in some cases, expose various specific metals to a corrosive environment, depending on factors such as the type and chemical content of the soil and the specific metal. Corrosive environments are also addressed in 680.14.

(B) Bonded Parts. …

(1) Conductive Pool Shells. …

(2) Perimeter Surfaces. The perimeter surface to be bonded shall be considered to extend for ~~1 m~~ 900 mm (3 ft) horizontally beyond the inside walls of the pool ~~and~~ while also at a height between 900 mm (3 ft) above and 600 mm (2 ft) below the maximum water level. The perimeter surface shall include unpaved surfaces, concrete, and other types of paving. Perimeter surfaces separated from the pool by a permanent wall or building 1.5 m (5 ft) in height or more shall

require equipotential bonding only on the pool side of the permanent wall or building. Bonding to perimeter surfaces shall be provided as specified in 680.26(B)(2)(a), (B)(2)(b), ~~or~~ (B)(2)(c), and (B)(2)(d). ~~and~~ For conductive pool shells where bonding to perimeter surfaces is required, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four points uniformly spaced around the perimeter of the pool, or if the bonded perimeter surface does not surround the entire pool, it shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four uniformly spaced points along the bonded perimeter surface. For nonconductive pool shells where bonding to the perimeter surfaces is required, bonding at four points shall not be required, and the perimeter bonding shall be attached to the 8 AWG copper equipotential bonding conductor and, if present, to any conductive support structure for the pool.

> Informational Note: Because the perimeter surface can incorporate various types of materials at various locations and elevations above and below maximum water level, the perimeter surface required to be bonded might not surround the entire pool. The 8 AWG copper equipotential bonding conductor can encircle the entire pool to facilitate connection of bonded parts.

(a) ~~*Structural Reinforcing Steel.* Structural reinforcing steel shall be bonded in accordance with 680.26(B)(1)(a).~~ *Conductive Paved Portions of Perimeter Surfaces.* Conductive paved portions of perimeter surfaces, including masonry pavers, if used, shall be bonded with unencapsulated structural reinforcing steel in accordance with 680.26(B)(1)(a), or with unencapsulated steel structural welded wire reinforcement (welded wire mesh, welded wire fabric), bonded together by steel tie wires or the equivalent. Steel welded wire reinforcement shall be fully embedded within the pavement unless the pavement will not allow for embedding. If the reinforcing steel is absent, or is encapsulated in a nonconductive compound, or embedding is not possible, unencapsulated welded wire steel reinforcement or a copper conductor grid shall be provided and shall be secured directly under the paving, and not more than 150 mm (6 in.) below finished grade.

Unencapsulated steel welded wire reinforcement that is not fully embedded in concrete, and copper grid regardless of location, where used for equipotential bonding, shall be listed for corrosion resistance and mechanical performance. This listing requirement shall become effective January 1, 2025. The copper grid or unencapsulated steel welded wire reinforcement shall also meet the following:

(1) Copper grid is constructed of 8 AWG solid bare copper and arranged in accordance with 680.26(B)(1)(b)(3).
(2) Steel welded wire reinforcement is minimum ASTM 6x6-W2.0 x W2.0 or minimum No. 3 rebar constructed in a 300 mm (12 in.) grid.
(3) Copper grid and steel welded wire reinforcement follow the contour of the perimeter surface extending not less than 900 mm (3 ft) horizontally beyond the inside walls of the pool.
(4) Only listed splicing devices or exothermic welding are used.

> Informational Note No. 1: Performance of the equipotential bonding system at the perimeter surface is improved as the distance between the bonding means and finished grade is minimized, either by embedding within, or by direct contact with the underside of, the finished pavement.

> Informational Note No. 2: See ASTM A615/A615M, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement;* A1064/A1064M, *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete;* A1022/A1022M, *Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement;* A1060A/A1060M, *Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete;* and ACI Standard ACI 318, *Building Code Requirements for Structural Concrete,* for examples of standards currently used in the listing of reinforcing steel bars and steel welded wire reinforcement.

(b) *Unpaved Portions of Perimeter Surfaces.* Unpaved portions of perimeter surfaces shall be bonded with any of the following methods:
(1) ~~*Copper Ring.* Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, a c~~Copper conductor(s) shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. At least one minimum 8 AWG bare solid copper conductor, including the 8 AWG copper equipotential bonding conductor if available ~~shall be provided~~.
~~(2)~~b. The conductors ~~shall~~ follow the contour of the perimeter surface.
~~(3)~~c. Only listed splicing devices or exothermic welding are used. ~~shall be permitted.~~
~~(4)~~d. The ~~required~~ conductor(s) is ~~shall be~~ 450 mm to 600 mm (18 in. to 24 in.) from the inside walls of the pool.
~~(5)~~e. The ~~required~~ conductor(s) ~~shall be secured within or~~ is under the unpaved portion of the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.
f. Be installed only in perimeter surfaces not intended to have direct access to swimmers in the pool.

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(~~e~~2) ~~*Copper Grid*. Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, c~~Copper grid or unencapsulated steel welded wire reinforcement used for equipotential bonding of unpaved portions of perimeter surfaces shall ~~be utilized where the following requirements are met~~ meet the following:
~~(1)~~a. ~~The copper grid shall be constructed of 8 AG solid bare copper and be arranged~~ Be installed in accordance with 680.26~~(B)(1)(b)(3)~~(B)(2)(a).
~~(2) The copper grid shall follow the contour of the perimeter surface extending 1 m (3 ft) horizontally beyond the inside walls of the pool.~~
~~(3) Only listed splicing devices or exothermic welding shall be permitted.~~
~~(4)~~b. ~~The copper grid shall be secured~~ Be located within ~~or under~~ the ~~deck or~~ unpaved surface(s) between 100 mm to 150 mm (4 in. to 6 in.) below ~~the subgrade~~finished grade.

(c) *Nonconductive Perimeter Surfaces.* Equipotential bonding shall not be required for nonconductive portions of perimeter surfaces that are separated from earth or raised on nonconducting supports, and it shall not be required for any perimeter surface that is electrically separated from the pool structure and raised on nonconductive supports above an equipotentially bonded surface.

> Informational Note: Nonconductive materials include, but are not limited to, wood, plastic, wood-plastic composites, fiberglass, and fiberglass composites.

(d) *Interconnection of Bonded Portions of Perimeter Surfaces.* All surfaces where equipotential bonding is required shall be interconnected using listed splicing devices or exothermic welding. Where copper wire is used for this purpose, it shall be solid copper, not smaller than 8 AWG. The conductor shall be permitted to encircle the pool to facilitate bonding connections to portions of the perimeter covered in 680.26(B)(2)(a) and (B)(2)(b) that are not contiguous.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 300.26
TIA 23-8
(SC 23-3-9 / TIA Log #1688)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 3 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 300.26 to read as follows:

300.26 Remote-Control and Signaling Circuits Classification.
Remote-control and signaling circuits shall be classified as either power-limited or non-power-limited and comply with ~~the following~~300.26(A) through (C).

(~~1~~A) **Class 1 Power-Limited Remote-Control and Signaling Circuits.** Class 1 power-limited remote-control and signaling circuits shall comply with 724.3.

(~~2~~B) **Class 2 and Class 3 Power-Limited Remote-Control and Signaling Circuits.** Class 2 and Class 3 power-limited remote-control and signaling circuits shall comply with 725.3.

(~~3~~C) **Non-Power-Limited Remote-Control and Signaling Circuits.** Non-power-limited remote-control and signaling circuits shall be installed in accordance with 300.2 through 300.25 and comply with 300.26(C)(1) through (C)(3).

(1) Sizes and Use.

(a) Conductors that are 18 AWG and 16 AWG copper shall be permitted to be used if they supply loads that do not exceed the ampacities specified in 402.5 and are installed in a raceway, an approved enclosure, or a listed cable.

(b) Conductors that are 14 AWG copper-clad aluminum shall be permitted to be used in Type MC cable and Type TC cable. The continuous load shall not exceed 8 amperes.

(c) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall not supply loads greater than the ampacities specified in 310.14.

(d) Flexible cords shall comply with the applicable general requirements, applications, and construction specifications for flexible cords and flexible cables in accordance with Article 400 Parts I and II.

(2) Insulation.

(a) Insulation on conductors shall be rated for the system voltage and not less than 600 volts.

(b) Conductors larger than 16 AWG copper or 14 AWG copper-clad aluminum shall comply with the applicable general requirements for conductors rated up to and including 2000 volt for type designations, insulations, markings, ampacity ratings, and uses in accordance with 310.3, 310.4, 310.6, 310.8, 310.10, and 310.14.

(c) Conductors that are 18 AWG copper, 16 AWG copper, or 14 AWG copper-clad aluminum shall be Type FFH-2, Type KF-2, Type KFF-2, Type PAF, Type PAFF, Type PF, Type PFF, Type PGF, Type PGFF, Type PTF, Type PTFF, Type RFH-2, Type RFHH-2, Type RFHH-3, Type SF-2, SFF-2, Type TF, Type TFF, Type TFFN, Type TFN, Type ZF, or Type ZFF.

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(d) Conductors with other types and thicknesses of insulation shall be permitted if listed for Class 1 circuit use.

(3) Overcurrent Protection.

(a) Overcurrent protection for conductors 14 AWG copper and larger shall be provided in accordance with the conductor ampacity, without applying the ampacity adjustment and correction factors specified in 310.15 to the ampacity calculation.

(b) Overcurrent protection shall not exceed 7 amperes for 18 AWG copper conductors and 10 amperes for 16 AWG copper and 14 AWG copper-clad aluminum.

Exception: The overcurrent protection specified in 300.26(C)(3)(1) and 300.26(C)(3)(2) shall not be required where this Code requires or permits other overcurrent protection ratings.

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: Table C.18, Table C.19 and Table C.20
TIA 23-7
(SC 22-12-7 / TIA Log #1678)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 8, and the NEC Correlating Committee, and was issued by the Standards Council on December 8, 2022, with an effective date of December 28, 2022.

*1. Revise Table Headers **only** for Table C.18, Table, C.19 and Table C.20 to read as follows:*

Table C.18 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.19 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

Table C.20 Number of Single Conductor Cables Permitted in Cable Tray
(Based on fill in accordance with 392.22, Table 392.22~~(A)~~(B)(1), column 1, ampacity in accordance with 392.80)

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Mod_11955_Text_TIA 23-7.pdf

Issue Date: December 8, 2022

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(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 555.35
TIA 23-6
(SC 22-8-23 / TIA Log #1660)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.35 to read as follows:

555.35 Ground-Fault Protection of Equipment (GFPE) and Ground-Fault Circuit Interrupter. For other than floating buildings, ground-fault protection for docking facilities shall be provided in accordance with 555.35(A) through (~~F~~D).

~~**(A) Sources Directly Supplying Docking Facilities or Wharfs.** Listed GFPE, rated not more than 100 milliamperes, shall be provided for sources directly supplying all docking facilities or wharfs. Coordination with downstream GFPE shall be permitted.~~

(~~B~~A) Feeder. …

Exception: Transformer secondary conductors of a separately derived system that do not exceed 3 m (10 ft) and are installed in a raceway shall be permitted to be installed without ground-fault protection. This exception shall also apply to the supply terminals of the equipment supplied by the transformer secondary conductors.

(~~C~~B) Branch-Circuits.

(1) Receptacles Providing Shore Power. …

(2) Outlets for Other than Shore Power. Outlets supplied by branch circuits not exceeding 150 volts to ground and 60 amperes, single phase, and 150 volts or less to ground, 100 amperes or less, three phase, shall be provided with GFCI protection for personnel.

Exception to (~~C~~B): Low-voltage circuits not requiring grounding, not exceeding the low-voltage contact limit and supplied by listed transformers or power supplies that comply with 680.23(A)(2) shall be permitted to be installed without ground-fault protection.

(~~D~~C) Boat Hoists. …

(~~E~~D) Leakage Current Measurement Device. …

Informational Note No. 1: …

Informational Note No. 2: …

Exception: Where the shore power equipment includes a leakage indicator and leakage alarm, a separate leakage test device shall not be required.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 555.30
TIA 23-5
(SC 22-8-22 / TIA Log #1659)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 555.30 to read as follows:

555.30 Electrical Equipment and Connections.

(A) General. All electrical components within electrical equipment (excluding wiring methods) and connections not intended for operation while submerged shall be located at least 305 mm (12 in.) above the deck of a fixed or floating structure, but not below the electrical datum plane. Conductor splices, within junction boxes identified for wet locations, utilizing sealed wire connector systems listed and identified for submersion shall be required for floating structures where located above the waterline but below the electrical datum plane.

(B) Replacements. …

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 215.15
TIA 23-4
(SC 22-8-18 / TIA Log #1655)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 215.15 to read as follows:

215.15 Barriers. Barriers shall be placed such that no energized, uninsulated, ungrounded busbar or terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations in panelboards, switchboards, switchgear, or motor control centers supplied by feeder taps in 240.21(B) or transformer secondary conductors in 240.21(C) when the disconnecting device, to which the tap conductors are terminated, is in the open position.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 210.8(F) and Exception No. 2(new)
TIA 23-3
(SC 22-8-17 / TIA Log #1654)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise paragraph 210.8(F) to read as follows:

210.8(F) Outdoor Outlets.

For dwellings, all outdoor outlets, other than those covered in 210.8(A), Exception No. 1, including outlets installed in the following locations, and supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, shall be provided with GFCI protection:

(1) Garages that have floors located at or below grade level
(2) Accessory buildings
(3) Boathouses

If equipment supplied by an outlet covered under the requirements of this section is replaced, the outlet shall be supplied with GFCI protection.

Exception No. 1: GFCI protection shall not be required on lighting outlets other than those covered in 210.8(C).

Exception No. 2: GFCI protection shall not be required for listed HVAC equipment. This exception shall expire September 1, 2026.

Issue Date: August 12, 2022

Effective Date: September 1, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: Article 100 (Ignitible Fibers/Flyings), 506.5, and 506.9(B)
TIA 23-2
(SC 22-4-8 / TIA Log #1617)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise Article 100 Ignitible Fibers/Flyings to read as follows:

Ignitible Fibers/Flyings. Fibers/flyings where any dimension is greater than 500 µm in nominal size, which are not likely to be in suspension in quantities to produce an explosible mixture, but could produce an ignitible layer fire hazard. [**499:**3.3.4.2]

Informational Note No.1: This definition and Informational Note No. 2 have been extracted from NFPA 499-2021, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.* The NFPA 499 reference is in brackets. Only editorial changes were made to the extracted text to make it consistent with this *Code.*

Informational Note No. 2: Section 500.5 of this *Code* prescribes a Class III location as one where ignitible fibers/flyings are present, but not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. This description addresses fibers/flyings that do not present a flash-fire hazard or explosion hazard by test. This could be because those fibers/flyings are too large or too agglomerated to be suspended in air in sufficient concentration, or at all, under typical test conditions. Alternatively, this could be because they burn so slowly that, when suspended in air, they do not propagate combustion at any concentration. In this document the zone classification system includes ignitible fibers/flyings as a fire hazard in a layer, which is not addressed in the IEC zone system (see IEC 60079-10-2, *Explosive atmospheres — Part 10-2: Classification of areas — Explosive dust atmospheres*). Where these are present, the user could also consider installation in accordance with Article 503 of this *Code.* [**499:**A.3.3.4.2]

2. Revise Section 506.5 to read as follows:

506.5 Classification of Locations.

(A) Classifications of Locations. …

(B) Zone 20, Zone 21, and Zone 22 Locations. …

(1) Zone 20. A Zone 20 location is a location where one of the following apply:

(1) Ignitible concentrations of combustible dust, ~~or~~ combustible fibers/flyings, or ignitible fibers/flyings are present continuously or for long periods of time.

…

(2) Zone 21. …

(3) Zone 22. A Zone 22 location is a location where one of the following apply:

(1) …

(2) Combustible dust, combustible fibers/flyings, or ignitible fibers/flyings are handled, processed, or used…

(3) …

3. Revise Section 506.9(B) to read as follows:

506.9 Equipment Requirements.

…

(B) Listing. Equipment that is listed for Zone 20 shall be permitted in a Zone 21 or Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying. Equipment that is listed for Zone 21 ~~can be used~~ shall be permitted in a Zone 22 location of the same combustible dust, combustible fiber/flying, or ignitible fiber/flying.

Issue Date: April 12, 2022

Effective Date: May 2, 2022

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo**)**

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Reference: 680.43, Exception No. 3
TIA 23-16
(SC 24-12-6 / TIA Log #1800)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 17, and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on December 4, 2024, with an effective date of December 24, 2024.

1. Delete Exception No. 3 of 680.43 as follows:

680.43 Indoor Installations. A spa or hot tub installed indoors shall comply with the provisions of Parts I and II of this article except as modified by this section and shall be connected by the wiring methods of Chapter 3.

Exception No. 1: Listed spa and hot tub …

Exception No. 2: The equipotential bonding …

~~*Exception No. 3: For a dwelling unit(s) only, where a listed spa or hot tub is installed indoors, the wiring method requirements of 680.42(C) shall also apply.*~~

Issue Date: December 4, 2024

Effective Date: December 24, 2024

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

E11955Text Modification

Tentative Interim Amendment

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Reference: 210.70
TIA 23-15
(SC 23-11-10/ TIA Log #1753)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by the NEC Code-Making Panel 2, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 210.70 to read as follows:

210.70 Lighting Outlets Required. Lighting outlets shall be installed where specified in 210.70(A), (B), and (C). The switch or listed wall-mounted control device shall not rely exclusively on ~~a~~ battery power unless ~~a~~ it incorporates a positive means of notification of impending battery depletion. ~~is provided for automatically energizing the lighting outlets upon battery failure.~~

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 517.30(B)(3)(a)
TIA 23-14
(SC 23-11-9 / TIA Log #1752)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by the NEC Code-Making Panel 15, and the Correlating Committee on National Electrical Code and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

1. Revise section 517.30(B)(3)(a) to read as follows:

517.30(B)(3) Fuel Cell Systems. Fuel cell systems shall be permitted to serve as the alternate power source for all or part of an EES. [**99:**6.7.1.5.1]

(a) Installation of fuel cells shall comply with the requirements in Parts I through VI ~~VII~~ of Article 692~~ for 1000 volts or less and Part VIII for over 1000 volts~~.

Issue Date: November 30, 2023

Effective Date: December 20, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 400.47
TIA 23-13
(SC 23-8-57 / TIA Log #1731)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by Code-Making Panel 6 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise section 400.47 to read as follows:

400.47. ~~Minimum~~ Conductor Bending ~~Radii~~ Radius. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 2000 volts to 5000 volts shall not ~~exceed~~ be bent to a radius less than six times the overall cable outer diameter. ~~The minimum bending radii for~~ P~~p~~ortable power feeder cables rated from 5001 volts to 25,000 volts shall not ~~exceed~~ be bent to a radius less than eight-times the overall cable outer diameter.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 408.6
TIA 23-12
(SC 23-8-56 / TIA Log #1699)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by Code-Making Panel 9 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 408.6 to read as follows:

408.6 Short-Circuit Current Rating. Switchboards, switchgear, and panelboards shall have a short-circuit current rating not less than the available fault current. In other than one- and two-family dwelling units, the available fault current and the date the calculation was performed shall be field marked on the enclosure at the point of supply. The marking shall be of sufficient durability to withstand the environment involved. ~~comply with 110.21(B)(3).~~

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Reference: 700.32(C), 701.32(C), and 708.54(C)
TIA 23-11
(SC 23-8-54 / TIA Log #1692)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code*®, 2023 edition. The TIA was processed by Code-Making Panel 13 and the Correlating Committee on National Electrical Code, and was issued by the Standards Council on August 25, 2023, with an effective date of September 14, 2023.

1. Revise 700.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

700.32 Selective Coordination.

700.32(A) General. Emergency system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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

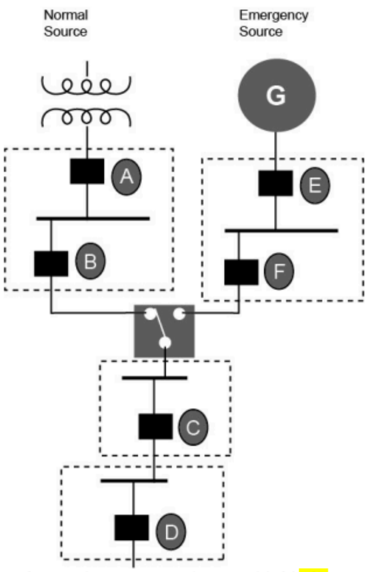
700.32(B) Replacements. Where emergency system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

700.32(C) Modifications. If modifications, additions, or deletions to the emergency system(s) occur, selective coordination of the emergency system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 700.32~~(C)~~ for an example of how emergency system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.~~



Informational Note Figure 700.32~~(C)~~ Emergency System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.

2. Revise 701.32(C) Informational Note and title of Figure for the Informational Note to read as follows:

701.32 Selective Coordination.

701.32(A) General. Legally required standby system(s) overcurrent protective devices (OCPDs shall be selectively coordinated with all supply-side and load-side OCPDs.

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

701.32(B) Replacements. Where legally required standby OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

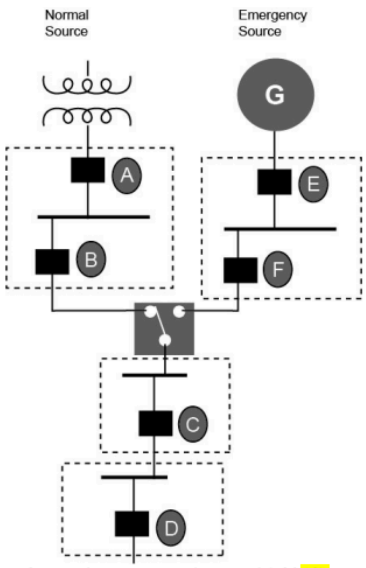
701.32(C) Modifications. If modifications, additions, or deletions to the legally required standby system(s) occur, selective coordination of the legally required system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 701.32~~(C)~~ for an example of how legally required standby system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.~~

E11955Text Modification



Informational Note Figure 701.32~~(C)~~ Legally Required Standby System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a legally required standby system OCPD.

3. Revise 708.54(C) Informational Note and title of Figure for the Informational Note to read as follows:

708.54(A) General. Critical operations power system(s) overcurrent protective devices (OCPDs) shall be selectively coordinated with all supply-side and load-side OCPDs.

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

708.54(B) Replacements. Where critical operations power system(s) OCPDs are replaced, they shall be reevaluated to ensure selective coordination is maintained with all supply-side and load-side OCPDs.

708.54(C) Modifications. If modifications, additions, or deletions to the critical operations power system(s) occur, selective coordination of the critical operations power system(s) OCPDs with all supply-side and load-side OCPDs shall be reevaluated.

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

Informational Note: See Informational Note Figure 708.54~~(C)~~ for an example of how critical operations power system OCPDs selectively coordinate with all supply-side OCPDs.

~~OCPD D selectively coordinates with OCPDs C, F, E, B, and A.~~
~~OCPD C selectively coordinates with OCPDs F, E, B, and A.~~
~~OCPD F selectively coordinates with OCPD E.~~
~~OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.~~

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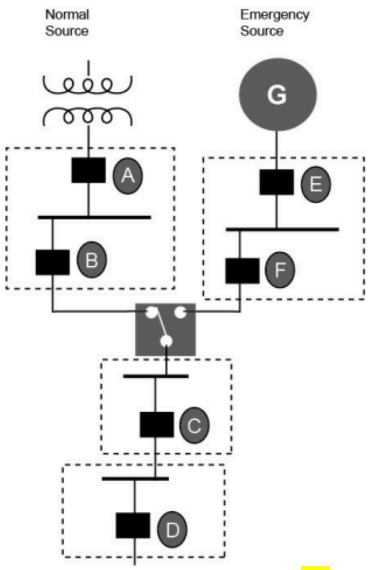
Mod_11955_Text_TIA 23-11.pdf

E11955Text Modification



Informational Note Figure 708.54~~(C)~~ Critical Operations Power System Selective Coordination.
OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
OCPD C selectively coordinates with OCPDs F, E, B, and A.
OCPD F selectively coordinates with OCPD E.
OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not a critical operations power system OCPD.

Issue Date: August 25, 2023

Effective Date: September 14, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

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Mod_11955_Text_TIA 23-11.pdf

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 314.29(A)
TIA 23-10
(SC 23-3-10 / TIA Log #1690)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 70®, *National Electrical Code®*, 2023 edition. The TIA was processed by the NEC Code-Making Panel 9 and the NEC Correlating Committee, and was issued by the Standards Council on March 21, 2023, with an effective date of April 10, 2023.

1. Revise paragraph 314.29(A) to read as follows:

314.29 Boxes, Conduit Bodies, and Handhole Enclosures to Be Accessible. Boxes, conduit bodies, and handhole enclosures shall be installed so that wiring and devices contained in the boxes, conduit bodies, or handhole enclosures can be rendered accessible in accordance with 314.29(A) and (B).

(A) In Buildings and Other Structures. Boxes and conduit bodies shall be installed so the contained wiring and devices are accessible. Boxes and conduit bodies that are recessed into or behind finished surfaces of buildings shall have access to their internal contents maintained by openings in their covers and in the building finish that comply with 314.29(A)(1), (A)(2), or (A)(3) as applicable. Removable finished covers and faceplates that maintain this access shall be permitted.

(1) Boxes 1650 cm^3 (100 in.^{3}) or Less in Size. The openings in the building surfaces, if reduced from the outer walls of the box, shall be centered not more than 25 mm (1 in.) from the centerline of the box, and shall not extend beyond the walls of the box. If rectangular, the opening shall be not less than 73 mm (2 7/8 in.) by 45 mm (1 3/4 in.) in size. If circular, the opening shall not be less than 90 mm (3½ in.) in diameter.

Exception: Smaller openings in building surfaces that accommodate one or more individual devices shall be permitted if all of the following conditions are met:

(1) The outlet box that supplies the device(s) is nonmetallic.
(2) The branch circuit wiring that supplies each device consists of a separate nonmetallic cable assembly originating outside the box, or individual sets of conductors in a single nonmetallic raceway, all of which originate outside the box. Other than the connections to a single device, these conductors are not spliced in the box or continued to another device, and no other wiring or raceways enter the box.
(3) Each device is capable of removal from the building surface opening without being damaged. If a special tool is required for this purpose, the applicable circuit directory for the device records the location of the tool, together with a product code/QR code for acquiring a replacement if necessary.
(4) All connections for each device to the branch circuit wiring are made with listed clamping-type wire connectors, which are supplied with the devices. The branch-circuit conductors are arranged to permit the connector(s) to be exposed after the device has been fully removed.
(5) The device assemblies are listed for this application.

(2) Boxes Larger Than 1650 cm^3 (100 in.^{3}) in Size. The openings shall not be smaller than the outer walls of the box.
(3) Conduit Bodies. The openings shall not be smaller than outer walls of the conduit body.
(B) Underground. Underground boxes and handhole enclosures shall be installed …

Issue Date: March 21, 2023

Effective Date: April 10, 2023

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Tentative Interim Amendment

NFPA® 70®

National Electrical Code®

2023 Edition

Reference: 250.114(3)e and 250.114(4)e
TIA 23-1
(SC 21-12-13 / TIA Log #1608)

Note: Text of the TIA was issued and approved for incorporation into the document prior to printing.

1. Revise 250.114(3)e and (4)e to read as follows:

250.114 Equipment Connected by Cord and Plug. Exposed, normally non-current-carrying metal parts of cord-and-plug-connected equipment shall be connected to the equipment grounding conductor under any of the following conditions:

…

(3) In residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

(4) In other than residential occupancies:

…

e. Portable handlamps ~~and portable luminaires~~

…

Issue Date: December 8, 2021

Effective Date: December 28, 2021

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)