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# IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits

IEEE Power and Energy Society

Sponsored by the
Nuclear Power Engineering Committee

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USA

**IEEE Std 384™-2018**
(Revision of IEEE Std 384-2008)

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Sponsor

**Nuclear Power Engineering Committee**
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**IEEE Power and Energy Society**

Approved 8 March 2018

**IEEE-SA Standards Board**

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**Abstract:** The independence requirements of the circuits and equipment comprising or associated with Class 1E systems are described in this standard. Criteria for the independence that can be achieved by physical separation and electrical isolation of circuits and equipment that are redundant are set forth. The determination of what is to be considered redundant is not addressed.

**Keywords:** associated circuit, barrier, Class 1E, IEEE 384™, independence, isolation, isolation device, raceway, separation

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## Introduction

This introduction is not part of IEEE Std 384-2018, IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits.

This standard provides criteria and requirements for establishing and maintaining the independence of Class 1E equipment and circuits and auxiliary supporting features by physical separation and electrical isolation. The 1992 revision of IEEE Std 384 incorporated separation criteria changes based on the results of separation testing completed by the nuclear industry on internally generated electrical faults. Where sufficient testing data were available, the separation distances were reduced. New configurations were also added including cable trays and conduits, cable trays and cable in free air, and conduits and cable in free air. See Annex B for additional discussion of the test programs.

The 2008 revision of IEEE Std 384 used the same testing programs that formed the basis for the 1992 revision and extrapolated the results, with margin, to produce separation criteria for fiber-optic cable. The isolation device requirements for control and instrumentation circuits in 6.2 were also enhanced to reflect the inherent electrical isolation characteristics of fiber-optic circuits. The revision also provided general guidance to address the effects of EMI/RFI and to provide a reference to Annex B of IEEE Std 603™ for further specific guidance.[1] The 2008 revision also changed the format of the distance criteria to be metric (followed by English units in parentheses) to match the usage criteria given in IEEE/ASTM SI 10™-2002 [B3].[2] Editorial improvements were also made, including updating the standard to the latest *IEEE Standards Style Manual*.

The IEEE has developed these criteria to provide guidance in the determination of the independence requirements related to the Class 1E systems of the nuclear facility. Adherence to these criteria may not fully address public health and safety issues because it is the integrated performance of the structures, the fluid systems, and the instrumentation and electrical systems of the station that determine the consequences of accidents. Failure to meet these requirements may be an indication of system inadequacy. Each applicant has the responsibility to provide assurance that this integrated performance is adequate.

The principal changes in this revision include the following:

Working Group for Independence Criteria and Design of Control Boards, Panels, and Racks (WG 6.5) reviewed IEEE Std 384-2008 and addressed the installation of mitigating equipment connections in regards to physical separation criteria and electrical isolation as a result of a beyond-design-basis external event (BDBEE), i.e., Fukushima event. This is done using administratively controlled Class 1E circuit interrupting devices to resolve the inability to provide protective device coordination between these devices and other circuit protective devices within the Class 1E distribution systems and to resolve the potential of automatic separation of power supply or load circuits that are required to respond to a BDBEE.

Other clauses of this standard have been reviewed, and improvements have been made, including updating the standard to the latest *IEEE Standards Style Manual*.

[1]Information on references can be found in Clause 2.
[2]The numbers in brackets correspond to those of the bibliography in Annex A.


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# IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits

## 1. Overview

### 1.1 Scope

This standard describes the independence requirements of the circuits and equipment comprising or associated with Class 1E systems. It sets forth criteria for the independence that can be achieved by physical separation and electrical isolation of redundant circuits and equipment that are redundant, but does not address the determination of what is to be considered redundant.

### 1.2 Purpose

This standard establishes the criteria for implementation of the independence requirements of IEEE Std 308™ and IEEE Std 603™.[3]

## 2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

ANSI/ANS 58.2, Design Basis for Protection of Light Water Nuclear Power Plants Against the Effects of Postulated Pipe Rupture.[4]

ANSI/NFPA 30, Flammable and Combustible Liquids Code.[5]

ANSI/NFPA 803, Standard for Fire Protection for Light Water Nuclear Power Plants.

ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.[6]

ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials.

ASTM E136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 °C.

[3]Information on references can be found in Clause 2.
[4]ANSI publications are available from the American National Standards Institute (http://www.ansi.org/).
[5]NFPA publications are published by the National Fire Protection Association (http://www.nfpa.org/).
[6]ASTM publications are available from the American Society for Testing and Materials (http://www.astm.org/).



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IEEE Std 308™, IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations.[7,8]

IEEE Std 338™, IEEE Standard Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems.

IEEE Std 379™, IEEE Standard for Application of the Single-Failure Criterion To Nuclear Power Generating Station Safety Systems.

IEEE Std 383™, IEEE Standard for Qualifying Electric Cables and Splices for Nuclear Facilities.

IEEE Std 420™, IEEE Standard for the Design and Qualification of Class 1E Control Boards, Panels, and Racks Used in Nuclear Power Generating Stations.

IEEE Std 603™, IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations.

IEEE Std 628™, IEEE Standard Criteria for the Design, Installation, and Qualification of Raceway Systems for Class 1E Circuits for Nuclear Power Generating Stations.

IEEE Std 690™, IEEE Standard for the Design and Installation of Cable Systems for Class 1E Circuits in Nuclear Power Generating Stations.

NEMA VE 1, Metal Cable Tray Systems.[9]

## 3. Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.[10]

**acceptable**: Demonstrated to be adequate by the safety analysis of the station.

**associated circuits**: Non-Class 1E circuits that are not physically separated or are not electrically isolated from Class 1E circuits by acceptable separation distance, safety class structures, barriers, or isolation devices. Circuits include the interconnecting cabling and the connected loads.

**auxiliary supporting features**: Systems or components that provide services (such as cooling, lubrication, and energy supply) that are required for the safety system to accomplish its safety functions.

**barrier**: A device or structure interposed between redundant Class 1E equipment or circuits, or between Class 1E equipment or circuits and a potential source of damage, to limit damage to Class 1E systems to an acceptable level.

**beyond-design-basis external event (BDBEE)**: Event initiated by natural phenomena that either exceeds the protections provided by design basis features or involves natural phenomena within the design basis in combination with beyond-design-basis failures leading to an extended loss of ac power and/or loss of ultimate heat sink.

**cable in free air**: That portion of a cable not routed in either a raceway or an enclosure.

**Class 1E**: The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing a significant release of radioactive material to the environment.

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