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DRAFT REGULATORY GUIDE

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(Proposed Revision 3 of Regulatory Guide 1.75)

CRITERIA FOR INDEPENDENCE OF ELECTRICAL SAFETY SYSTEMS

A. INTRODUCTION

Section 50.55a, "Codes and Standards," of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires in 10 CFR 50.55a(h) that protection systems for plants with construction permits issued after January 1, 1971, but before May 13, 1999, must meet the requirements stated in either IEEE Std 279, "Criteria for Protection Systems for Nuclear Power Generating Stations,"[1] or IEEE Std 603-1991, "Criteria for Safety Systems for Nuclear Power Generating Stations."[1] For nuclear power plants with construction permits issued before January 1, 1971, protection systems must be consistent with their licensing basis or may meet the requirements of IEEE Std 603-1991. The safety systems for plants with construction permits issued after May 13, 1999, must meet the requirements of IEEE Std 603-1991.

Section 4.6 of IEEE Std 279-1971 requires, in part, that channels that provide signals for the same protective function be independent and physically separated. Section 5.6.1 of IEEE Std 603-1991 states, "Redundant portions of a safety system provided for a safety function shall be independent of and physically separated from each other to the degree necessary to retain the capability to accomplish the safety function during and following any design basis event requiring that safety function." General Design Criterion 3, "Fire Protection," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 requires, in part, that certain structures, systems, and components be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions. General Design Criterion 17, "Electric Power Systems." requires, in part, that electric power

[1] IEEE standards are available from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08855 (800-678-4333).

from the transmission network to the onsite electric distribution system be supplied by two physically independent circuits designed and located so as to minimize the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. General Design Criterion 21, "Protection System Reliability and Testability," requires, in part, that redundancy and independence designed into the protection system must be sufficient to assure that no single failure results in loss of the protection function. General Design Criterion 22, "Protection System Independence," requires that the effects of natural phenomena, and normal operating, maintenance, testing, and postulated accident conditions, on redundant channels do not result in loss of the protection function.

This regulatory guide describes a method acceptable to the NRC staff for complying with the NRC's regulations with respect to the physical independence requirements of the circuits and electric equipment that compose or are associated with safety systems.

Regulatory guides are issued to describe to the public methods acceptable to the NRC staff for implementing specific parts of the NRC's regulations, to explain techniques used by the staff in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations, and compliance with regulatory guides is not required. Regulatory guides are issued in draft form for public comment to involve the public in developing the regulatory positions. Draft regulatory guides have not received complete staff review; they therefore do not represent official NRC staff positions.

The information collections contained in this draft regulatory guide are covered by the requirements of 10 CFR Part 50, which were approved by the Office of Management and Budget (OMB), approval number 3150-0011. The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

IEEE Std 384-1992, "Standard Criteria for Independence of Class 1E Equipment and Circuits,"[1] was prepared by Working Group SC 6.5 of IEEE Nuclear Power Engineering Committee and was approved by the Standards Board on June 18, 1992. This standard provides criteria and requirements for establishing and maintaining the independence of safety-related equipment and circuits and auxiliary supporting features by physical separation and electrical isolation. Based on the results of separation testing completed by the nuclear industry on internally generated electrical faults, the following significant changes were incorporated in IEEE Std 384-1992: (1) separation distance criteria for certain configurations (identified in IEEE Std 384-1981) were reduced, and (2) separation distance criteria were added for configurations that were not previously addressed. These configurations include cable trays and conduits, cable trays and cable in free air, and conduits and cable in free air.

The underlying separation criteria is that physical separation and electrical isolation must be provided to maintain the independence of safety-related circuits and equipment so that the safety functions required during and following any design basis event can be accomplished.

Section 5.6(3) of IEEE Std 384-1992 seems to allow analysis of non-safety-related circuits to demonstrate that safety-related circuits are not degraded below an acceptable level. Thus, if the analysis works, one may imply that the non-safety-related circuits are not "associated circuits." However, in Section 5.5.2(3), the analyzed circuits are still called "associated circuits." The staff position is that non-safety-related circuits must be treated as "associated circuits."

C. REGULATORY POSITION

Conformance with the requirements of IEEE Std 384-1992, "Standard Criteria for Independence of Class 1E Equipment and Circuits," provides a method acceptable to the NRC staff for satisfying the NRC's regulations with respect to the physical independence requirements of the circuits and electric equipment that compose or are associated with safety systems, subject to the following:

1. Sections 7.1.2.1, 7.1.2.4, and 7.2.2.3 of IEEE Std 384-1992 should be supplemented as follows: The breaker or fuse automatically opened by fault current may be used as an isolation device provided (a) the breaker, or fuse time-overcurrent trip characteristics, for all circuit faults under bolted and arcing fault conditions (assuming multiple faults of all non-safety-related loads) will cause the circuit breaker to interrupt the fault current prior to initiation of a trip of any upstream circuit breaker, and (b) periodic testing during every refueling must demonstrate that the overall coordination scheme under multiple faults of all non-safety-related loads remains within the limits specified in the design criteria for the nuclear power plant.

2. The summary results of the analysis performed to meet the requirements of IEEE Std 384-1992, for example, to comply with Sections 5.5.2, 5.6, 6.1, etc, should be included in the Final Safety Analysis Report for the nuclear power plant.

3. Section 6.1.1.2 of IEEE Std 384-1992 should be supplemented as follows: Cable splices in raceways should generally be avoided to the extent it is practical.

4. Section 5.6(3) of IEEE Std 384-1992 should not be construed as allowing less than minimum separation of non-safety-related circuits from safety-related circuits to be justified by analyses without treatment of the affected non-safety-related circuits as associated circuits.

5. Section 3 of IEEE Std 384-1992 references several industry codes and standards. If a referenced standard has been separately incorporated into the NRC's regulations, licensees and applicants must comply with the standard as set forth in the regulation. If the referenced standard has been endorsed by the NRC staff in a regulatory guide, the standard constitutes an acceptable method of meeting a regulatory requirement as described in the regulatory guide. If a referenced standard has been neither incorporated into the NRC's regulations nor endorsed in a regulatory guide, licensees and applicants may consider and use the information in the referenced standard, if appropriately justified, consistent with regulatory practice.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this guide. No backfitting is intended or approved in connection with the issuance of this guide.

This proposed revision has been released to encourage public participation in its development. Except in cases in which an applicant or licensee proposes or has previously established an acceptable alternative method for complying with specified portions of the NRC's regulations, the methods described in the effective version of this guide will be used in the evaluation of (1) submittals in connection with applications for construction permits, design certifications, operating licenses, and combined licenses for application of independence criteria to safety systems, and (2) submittals from operating reactor licensees who voluntarily propose to initiate system modifications if there is a clear nexus between the proposed modifications and this guidance with respect to the physical independence requirements of the circuits and electrical equipment that compose or are associated with safety systems.

REGULATORY ANALYSIS

BACKGROUND

Physical separation and electrical isolation must be provided to maintain the independence of safety-related circuits and equipment so that the safety functions required during and following any design basis event can be accomplished. The physical separation of circuits and equipment should be achieved by use of safety class structures, separation distance, or barriers, or any combination thereof. The independence of safety-related circuits and equipment must not be compromised by the functional failure of auxiliary supporting features.

1. PROBLEM

In September 1978, Revision 2 of Regulatory Guide 1.75, "Physical Independence of Electric Systems," was issued to describe acceptable methods for complying with the NRC's regulations with respect to the physical independence of the circuits and electric equipment. This was accomplished by the conditional endorsement of IEEE Std 384-1974, "IEEE Trial-Use Standard Criteria for Separation of Class 1E Equipment and Circuits." When Regulatory Guide 1.75 was issued, the NRC staff had planned to update the guide after the expiration of the trial period of IEEE Std 384-1974. However, the NRC staff has never updated Regulatory Guide 1.75 as previously planned.

Since the issuance of Revision 2 of Regulatory Guide 1.75, IEEE Std 384-1974 has been revised and published as a new edition in 1977, 1981, and 1992. IEEE Std 384-1992 reflects the results of separation testing completed by the nuclear industry on internally generated electrical faults. Separation distance criteria for certain configurations have been reduced. Separation distance criteria for certain other configurations that were not previously addressed were added based on the test results. Therefore, the guidance in Revision 2 of Regulatory Guide 1.75 has become outdated.

2. OBJECTIVE

The objective of the regulatory action is to update NRC guidance on independence criteria for safety-related circuits and equipment.

3. TECHNICAL APPROACH

IEEE Std 384-1992 cumulatively addresses the regulatory positions and issues identified in the September 1978 issue of Regulatory Guide 1.75 as follows. The staff took 16 exceptions to IEEE Std 384-1974.

Regulatory Position 1: The staff recognizes that a properly applied and coordinated circuit breaker or fuse can be used as an isolation device, subject to the conditions stated in the new Regulatory Position 1 in this draft regulatory guide. Since the isolation device is safety-related by definition, its failure is the single failure that must be assumed in any accident analysis.

Regulatory Position 2: Resolved, since the definition of "raceway" was modified in IEEE Std 384-1992.

Regulatory Position 3: The staff recognizes that it is somewhat unrealistic to try to locate redundant circuits and equipment in separate class structures, especially since the location of the cables is dictated to a large extent by the location of the process equipment. This Regulatory Position is considered resolved.

Regulatory Position 4: Resolved. Section 5.5.2 of IEEE Std 384-1992 was revised.

Regulatory Position 5: The NRC staff recognizes that the notes are part of an IEEE standard. This Regulatory Position is considered resolved.

Regulatory Position 6: The NRC staff recognizes that submission of every analysis via FSAR is burdensome. Therefore, the staff has now adopted the position that only summary results may be included in the FSAR (see new Regulatory Position 2 in this draft regulatory guide).

Regulatory Position 7: Resolved. Section 5.6 of IEEE Std 384-1992 was revised.

Regulatory Position 8: This is addressed by the last sentence in Section 6.1.1.1 of IEEE Std 384-1992, which reads, “Opposite sides of rooms or areas may be used provided there is an adequate heat removal capability.”

Regulatory Position 9: The staff recognizes that cable splices in cable trays cannot be avoided. Field splices should be strictly limited to special circumstances. See new Regulatory Position 3 in this draft regulatory guide.

Regulatory Position 10: Resolved. Section 6.1.2 of IEEE Std 384-1992 was revised.

Regulatory Position 11: Resolved. The last paragraph of Section 6.1.2 of IEEE Std 384-1992 addresses this position.

Regulatory Position 12: Resolved. Section 5.1.3 was deleted.

Regulatory Position 13: Resolved. The figure depicting cable trays of different widths was deleted.

Regulatory Position 14: The requirement for independent air supplies is beyond the scope of this regulatory guide.

Regulatory Position 15: The requirement for independent ventilation systems is beyond the scope of this regulatory guide.

Regulatory Position 16: Resolved. Section 6.7 of IEEE Std 384-1992 was revised.

4. CONCLUSION

It is recommended that the NRC revise Regulatory Guide 1.75, since this action should enhance the licensing process. The staff has concluded that the proposed action will reduce unnecessary burden on both the NRC and its licensees, and it will result in an improved process for the design and evaluation of the independence criteria. Furthermore, the staff sees no adverse effects associated with revising Regulatory Guide 1.75. Use of this revision is optional by licensees of the currently operating nuclear power plants. It is, in fact, beneficial to the licensees since this regulatory guide provides relaxation of NRC requirements in several areas.

BACKFIT ANALYSIS

The regulatory guide does not require a backfit analysis as described in 10 CFR 50.109(c) because the use of this revision of Regulatory Guide 1.75 is voluntary by the licensees of currently operating nuclear power plants.