



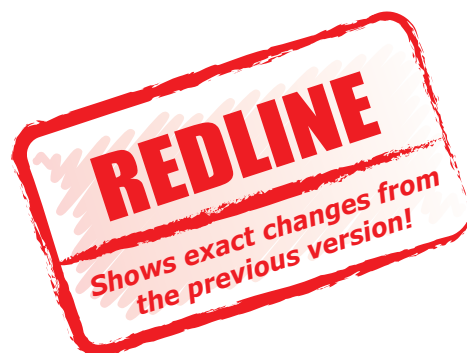
IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations

IEEE Power & Energy Society

Sponsored by the
IEEE Nuclear Power Engineering Committee

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IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations

Sponsor

IEEE Nuclear Power Engineering Committee
of the
IEEE Power & Energy Society

Approved 11 September 2009

IEEE-SA Standards Board

Abstract: Minimum functional and design criteria for the power, instrumentation, and control portions of nuclear power generating station safety systems are established. The criteria are to be applied to those systems required to protect the public health and safety by functioning to mitigate the consequences of design basis events. The intent is to promote appropriate practices for design and evaluation of safety system performance and reliability. Although the standard is limited to safety systems, many of the principles may have applicability to equipment provided for safe shutdown, post accident monitoring display instrumentation, preventive interlock features, or any other systems, structures, or equipment related to safety.

Keywords: actuated equipment, associated circuits, Class 1E, design, failure, maintenance bypass, operating bypass, safety function, sense and command features, sensor

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Introduction

This introduction is not part of IEEE Std 603-2009, IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations.

This standard establishes minimum functional design criteria for the power, instrumentation, and control portions of nuclear power generating station safety systems. These criteria are established to provide a means for promoting appropriate practices for design and evaluation of safety system performance and reliability. However, adhering to these criteria will not necessarily fully establish the adequacy of any safety system's functional performance and reliability; nonetheless, omission of any of these criteria will, in most instances, be an indication of safety system inadequacy.

Application

The criteria established by this standard apply to those systems defined as safety systems and do not necessarily apply to all the structures, systems, and components required for comprehensive plant safety. Although the scope is limited to safety systems, many of the principles may have applicability to equipment provided for safe shutdown, accident monitoring display instrumentation, preventive interlock features, or any other structures, systems, and components related to safety, or all of the above.

To determine those systems subject to these criteria, an analysis of the overall plant response to postulated design basis events shall be performed. Good engineering judgment should be exercised in this analysis so that the adequate margins exist in the design to protect the health and safety of the public without imposing unduly restrictive criteria on the design.

Interdisciplinary approach

The safety system criteria herein are established using a systems approach to the design of the power, instrumentation, and control portion of the safety system, as opposed to a specific engineering discipline approach (that is, electrical, mechanical, or civil). It is recognized that the safety functions cannot be accomplished without mechanical as well as electrical equipment and circuitry. It shall also be recognized that some safety functions may be implemented using digital computers and computer programs. Therefore, the design by other disciplines should consider these criteria. In order for the safety system to meet the requirements of this standard and the supportive standards, the aggregate design of the safety system (without regard to discipline) may be constrained. For example, the consideration of common-cause failure is an item that requires interdisciplinary review and design solution. Such constraints are themselves implicit interface requirements imposed upon the individual constituent parts to enable the entire safety system to meet these requirements. The areas where this standard interfaces with other standards are shown in Figure 1.

While this standard takes a systems approach to the design of the power, instrumentation, and control portion of the safety system, it does not attempt to establish new or different criteria for mechanical equipment or components. Such an attempt by a user is a misapplication of this standard. Nor does this standard attempt to establish the system-level requirements that may be required by mechanical or civil equipment; for example, in-service inspection of piping is intentionally excluded. This standard provides criteria for the safety system without conflicting with existing standards. This standard is not intended to duplicate or conflict with component design requirements such as the ASME Boiler and Pressure Vessel Code [B5].^a Rather this standard is to complement and interface with such documents. This standard and

^a The numbers in brackets correspond to those of the bibliography in Annex C.

others establish systems criteria while additional codes and standards establish detailed requirements for the functional adequacy of the individual constituent parts of the safety system.

Evolution

This standard was evolved from IEEE Std 603-1980. It represents the latest Subcommittee 6 (SC-6) publication of a systems criteria document. The series began with IEEE Std 279TM-1968, a trial-use standard for protection systems. This was followed by IEEE Std 279-1971 [B7], a standard for protection systems; IEEE Std 279-1971 has since been withdrawn. IEEE Std 603-1977, a trial use standard for safety systems was issued in 1977. IEEE Std 603 was revised and issued in 1980, 1991, and 1998. This latest issue represents the current revision to the IEEE standard for safety systems.

Relationship to other standards

This standard establishes functional and design criteria that are general in nature. It requires supportive standards containing both general and detailed criteria to comprise a minimal set of requirements for the safety system.

Other IEEE standards prepared in support of the criteria of this standard are referenced throughout this standard. Various other standards by organizations such as American National Standards (ANS), the International Atomic Energy Agency (IAEA), International Electricity Commission (IEC), and American Society of Mechanical Engineers (ASME) provide additional information on aspects covered in this standard.

International standard IEC 60231A (1969-01) also contains functional and design criteria for safety systems.

The definition of the term *safety system* in Clause 3 references the Code of Federal Regulations Title 10 Part 100.^b This definition is the same as used by other groups, such as the ANS and Instrumentation Society of America (ISA). This is per agreements made with other organizations.

Purpose of revision

The purpose of this revision is to revise the existing standard document to 1) reflect current industry practices and user feedback, 2) align the document for compatibility with related IEEE standards, and 3) incorporate the results of future work items identified in the forward from the 1998 version of IEEE Std 603.

IEEE Std 603 was revised to recognize the issuance of IEEE Std 497TM-2002. Although the forward of IEEE Std 603-1998 stated that ANSI/ANS-4.5-1980 [B1] and IEEE Std 497-1981 were to be combined as ANS 4.5, ANS 4.5-1989 was withdrawn and IEEE Std 497 was revised and issued in 2002.

References to ANSI/ANS 51.1-1983, Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants, and ANSI/ANS 52.1-1983, Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactor Plants, were removed since these standards were withdrawn by the ANS.

^b Information on references can be found in Clause 2.

Future work

- Annex B enhancements on EMI/RFI.

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1. Overview

1.1 Scope

The criteria contained in this standard establish minimum functional and design requirements for the power, instrumentation, and control portions of safety systems for nuclear power generating stations. To satisfy the criteria in this standard, interface requirements may be imposed on the other portions of the safety system as shown in Figure 1. Safety system functional and design criteria are also contained in other standards.¹

1.2 Illustration

Figure 1 depicts the potential for interface requirements to be imposed on the other portions of the safety system.

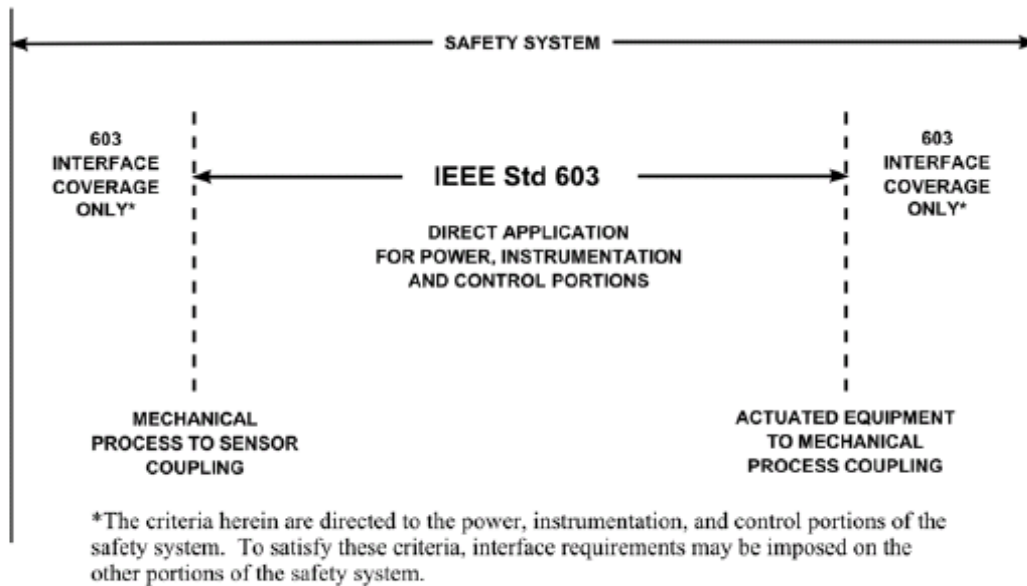


Figure 1—Non-electrical interface scope diagram

Figure 2 illustrates the scope of this standard in the form of a three by three matrix. The labeling across the top of the matrix illustrates that the safety systems can be subdivided into the three general elements of sense and command features, execute features, and power sources. These general elements represent a grouping of devices that provides similar performance characteristics for many discrete safety functions. The labeling on the left side of the matrix illustrates that the safety systems can also be subdivided into the three operational elements of reactor trip system and engineered safety features, auxiliary supporting features, and other auxiliary features. When viewing an entire row of the matrix, it can be seen that an operational element may form a system.

Illustrating the scope of this standard in matrix form shows that each operational element contains one or more general elements. This matrix should not be interpreted to mean that every operational element shall contain all of the general elements or that a particular general element is limited to application in only one operational element.