U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Proposed Path Forward for Industry's Use of Institute of Electrical and Electronics Engineers Standard (IEEE) 603-2018, Criteria for Safety Systems

10 CFR 50.55a(h), IEEE Std 279, IEEE Std 603
Reg. Guide 1.153

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Agenda

- Purpose
- Background
- Problem statement
- Discussion on path forward for IEEE 603-2018
  - Considerations
  - Objectives to enable use of newer standards
  - Summary of options
- Next steps

Meeting Purpose

To present the staff's options on a path forward to address the use of the 2018 version of IEEE 603, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," in the development of safety-related instrumentation and control (I&C) systems.

- Obtain stakeholder feedback on the staff's options.
- Obtain stakeholder feedback on other possible options to enable the use of future revisions to standards.
- Gain a better understanding of industry's needs for meeting the requirements for the design of protection systems for operating, new, and advanced reactors.
- Help inform the staff's decision on which option(s) to proceed with for meeting the objectives of the IEEE 603 activities.

Background

- **Regulations for the design of protection systems for nuclear power plants**
  - Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(h), Protection and safety systems
  - IEEE 279-1971 and IEEE 603-1991 are incorporated by reference (IBR'd) into 10 CFR 50.55a(h)

- **Guidance for complying with the regulations**
  - Regulatory guide (RG) 1.153, Revision 1,
    - Endorses IEEE 603-1991
    - Describes a method acceptable to the NRC staff for complying with the Commission's regulations with respect to the design, reliability, qualification, and testability of the power, instrumentation, and control portions of safety systems of nuclear plants.
    - Published in 1996

- **The issuance of RG 1.153, Revision 1 <u>preceded</u> the incorporation by reference of IEEE Std. 603-1991 into 10 CFR 50.55a(h).**
  - RG 1.153, Revision 0 endorsed IEEE 603 as a method to comply with IEEE 279-1971, then incorporated into the regulations, and portions of several General Design Criteria (GDCs)

Problem Statement

- **Incorporation by reference (IBR) of IEEE 603-1991 into 10 CFR 50.55a(h) created licensing challenges with using later versions of IEEE 603**

- **Currently, the NRC's regulations do not address the use of the latest version of IEEE 603 (i.e., 2018) in meeting our protection and safety system requirements in 10 CFR 50.55a(h)**
  - Applicants must comply with that standard as set forth in the regulation
  - RG 1.153, Revision 1 became redundant

- **The NRC staff initiated the IEEE 603 activities to address challenges**
  - Develop a path forward for the use of the latest version of IEEE 603 (i.e., 2018)
  - Will improve the clarity and reliability of the DI&C regulatory infrastructure

Path Forward: Considerations

- **Existing requirements and guidance**
  - IEEE 603-1991 is IBR'd into 10 CFR 50.55a(h)
  - RG 1.153, Revision 1 endorses IEEE 603-1991
- **IEEE 603-1991 vs. IEEE 603-2018**
  - Assessment of the differences between the 1991 and 2018 versions
- **Industry needs**
  - Leverage technology advancements with newer standards
- **Modernization of the NRC's I&C regulatory infrastructure**
  - Reduced complexity that enables the expanded safe use of digital technologies (SECY 19-0112)

Staff Assessment: 1991 vs. 2018

- **The staff performed an assessment to determine differences between the 1991 and 2018 versions of IEEE 603**

Summary of IEEE 603-2018 revisions:

- Addresses corrections in the January 30, 1995, correction sheet
- Contains additional and updated references (removes references that are no longer in effect)
- Enhances interconnected equipment provisions to contain classification requirements for equipment not credited to perform a safety function but connected to safety-related equipment
- Addresses potential safety issues that may arise from incorporating components that use advanced digital technologies in safety systems
- Provides guidance to address electromagnetic compatibility issues
- Adds new criteria for common cause failure
- Includes provisions on electrical isolation and digital communication independence between safety systems and non safety related systems

Path Forward: Objectives to Enable the Use of Newer Standards

The NRC staff has two principal objectives for providing a licensing pathway for using newer standards to address regulatory criteria for I&C safety systems:

1. Provide industry with the regulatory confidence to use the 2018 version of the standard in the development of safety related I&C systems.

2. Establish a path to endorse new and improved standards that are developed to address digital technology advancements without a need to change regulatory requirements through the rulemaking process (i.e., standards that are IBR'd into the regulations).

Supports the NRC's vision to establish a modern, risk-informed regulatory infrastructure with reduced uncertainty that will enable the expanded safe use of digital technologies in new reactor designs and operating plants.

Path Forward: Options Under Consideration

- **The staff is considering three options to satisfy the objectives:**
  - Option 1: Revise a RG (e.g., RG 1.153)
  - Option 2: Rulemaking (IBR of IEEE 603-2018)
  - Option 3: Issue generic communication

Option 1: Revise a RG

Details:

- The revised RG would provide an endorsement of the new provisions identified in IEEE 603-2018.
- For the changes, the applicable requirements would need to be identified to endorse.
- The Background of the RG would be updated to include a table that has side-by-side clauses with an explanation of changes and analysis of the effect of each change.
- The table will provide applicants with the regulatory confidence for using the 2018 version to demonstrate compliance with the regulations (i.e., 1991 version)

Path to Success:

- Identify the changes between the 1991 and 2018 versions of IEEE 603
- Identify the applicable requirements for the changes in the 2018 version
- Identify the appropriate RG to revise (e.g., revise RG 1.153, sunset RG 1.153 if another RG is revised, etc.)

Attributes:

- Improves the clarity and usability of the NRC's I&C regulatory infrastructure
- Only satisfies Objective 1 to enable the use of newer standards

Option 2: Rulemaking (IBR of IEEE 603-2018)

Details:

- IBR the 2018 standard into Part 50
- Utilize the 1976 EDO Delegation of Authority (i.e., routine updates to codes and standards previously approved by the Commission for IBR)

Path to Success:

- Will need to inform the Commission of the staff's rulemaking plans
- Will need to determine if the changes in IEEE 603-2018 are routine in nature and represent the updating of basic codes and standards previously approved by the Commission for IBR.

Attributes:

- Identifies and addresses distinctions between technically equivalent clauses and new provisions.
- Provides clarity to all stakeholders.
- Schedule risk if 1976 delegation of authority cannot be utilized (e.g., updates are not routine).
- Several Reg. Guides will need to be updated to reflect the new regulatory basis established by the rule.
- Only satisfies Objective 1 to enable the use of newer standards

Option 3: Issue Generic Communication

Details:

- Summarize the changes in the 2018 version.
- Summarize the licensing pathway for applicants to use newer versions of IEEE 603, as long as their applications demonstrate compliance with the 1991 version.

Path to Success:

- Identify previous licensing practices of using IEEE 603-2018

Attributes:

- Provides clarity on previous practices for using the latest version of IEEE 603
- Provides informational crosswalk of the 2018 changes to stakeholders
- Does not modernize the NRC's I&C regulatory infrastructure
- Only satisfies Objective 1 to enable the use of newer standards

Other Options

- **The staff may identify other options in the future for meeting Objective 2 of this activity**
  - Establish a path to endorse new and improved standards

- **Possible other options:**
  - Removal of IEEE standards referenced in 50.55a
  - Use of international standards (e.g., International Electrotechnical Commission (IEC) standards)

- **The staff is open to stakeholder feedback on identifying additional options for demonstrating compliance with the regulations**

Next Steps

- **Assess stakeholder feedback**
  - Use as input to inform staff's decision on path forward (selection of option)
- **Decide on path forward and option to implement**
  - Notify stakeholders on path forward
- **Continue to engage with stakeholders as staff implements path forward**

Questions?

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Back up Slides

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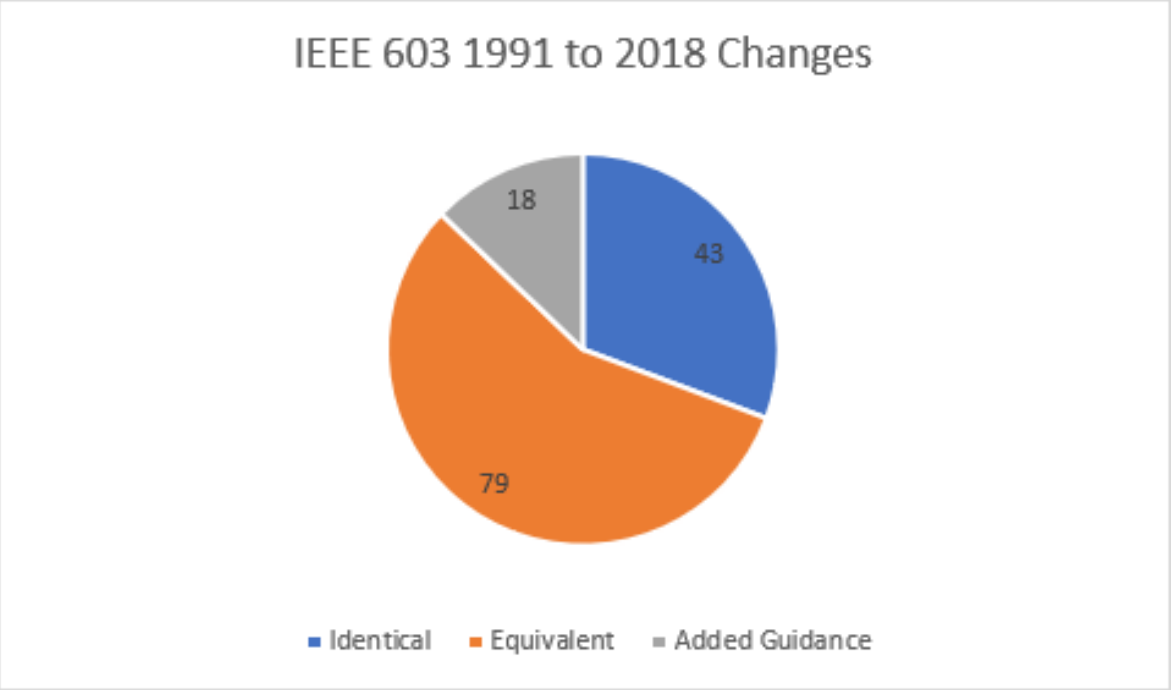
IEEE 603 Change Statistics

- **Changes between 1991 and 2018 versions of IEEE Std 603**
  - Identical clauses = 43
  - Equivalent clauses = 79
  - Clauses providing new or revised criteria = 18



(Examples of each of these categories are provided on the following slides)

Example 1 (Identical Clause)

- **IEEE 603-1991, Clause 5.9**

The design shall permit the administrative control of access to safety system equipment. These administrative controls shall be supported by provisions within the safety systems, by provision in the generating station design, or by a combination thereof.

- **IEEE 603-2018, Clause 5.9**

The design shall permit the administrative control of access to safety system equipment. These administrative controls shall be supported by provisions within the safety systems, by provision in the generating station design, or by a combination thereof.

Analysis: Not a single word, clause number, punctuation or reference is different. The clause is completely identical to the same clause in IEEE 603-1991.

Example 2 (Equivalent Clause)

- **IEEE 603-1991, Clause 4.5.3**

The range of environmental conditions imposed upon the operator during normal, abnormal, and accident circumstances throughout which the manual operations shall be performed.

- **IEEE 603-2018, Clause 4.5.3**

The range of environmental conditions imposed upon the operator during normal, abnormal, and accident conditions throughout which the manual operations shall be performed.

Analysis: Single word changed; “accident circumstances” replaced with "accident conditions." Two words have similar meaning, and criteria was determined to be equivalent. Accident conditions is a more widely accepted term by the NRC and the nuclear industry.

Example 3 (Equivalent Clause)

- **IEEE 603-1991, Clause 5.8.4**

Information displays shall be located accessible to the operator. Information displays provided for manually controlled protective actions shall be visible from the location of the controls used to effect the actions.

- **IEEE 603-2018, Clause 5.8.4**

Information displays shall be accessible to the operator. Information displays provided for manually controlled protective actions shall be readable from the location of the controls used to perform the actions.

Analysis: Clause has been re-worded to provide clarification, but the criteria are considered to be equivalent.

Example 4 (Equivalent Clause)

- **IEEE 603-1991, Clause 4.12**

Any other special design basis that may be imposed on the system design (example: diversity, interlocks, regulatory agency criteria).

- **IEEE 603-2018, Clause 3.m)**

Any other special design basis that may be imposed on the system design (e.g., to address topics such as diversity or interlocks).

Analysis: Clause number changed due to restructuring. Criterion is identical but the parenthetical examples were changed to omit the generic term "regulatory agency criteria," which does not provide a useful specific example. This is considered equivalent.

Example 5 (New Criteria Clause)

- **IEEE 603-1991, Clause 5**

The safety systems shall, with precision and reliability, maintain plant parameters within acceptable limits established for each design basis event.

- **IEEE 603-2018, Clause 2)**

The following requirements make sure the safety systems maintain plant parameters within acceptable limits established for each design basis event with precision and reliability. IEEE Std 7-4.3.2 provides additional digital system requirements to supplement the criteria and requirements of this standard.

Analysis: Clause number changed due to restructuring. Criteria reworded but maintained. Added reference to IEEE 7-4.3.2.

Note: The NRC endorses the use of IEEE 7-4.3.2 via RG 1.152, Revision 4. If IEEE 603-2018 is incorporated by reference in the future, the referenced criteria of IEEE 7-4.3.2 would not be part of that incorporation and thus would not become regulatory requirements.

Example 6 (New Criteria Clause)

- **IEEE 603-1991**

  No equivalent criteria.

- **IEEE 603-2018, Clause 4.8)**

  Analyses shall be performed to identify and address these potential hazards of the system and shall be used to establish design basis. These analyses should determine which hazards require system design provisions to retain the capability to perform the safety functions or require other means to maintain plant safety.

Analysis: The NRC staff considers hazards analysis techniques to be acceptable methods for ensuring that system reliability goals are met and for demonstrating compliance with Clause 4.8