Incorporation of IEEE 603-2009 to Regulation on Safety Classification and Applicable Codes for Nuclear Reactor Facilities

Sang Hun Lee [a*]
[a]*Dept. of I&C and Elec. Eng., Korea Institute of Nuclear Safety, 62 Gwahak-ro, Yuseong-gu, Daejeon 34142*
[*]*Corresponding author: lees@kins.re.kr*

Keywords : Safety I&C System, Regulation, IEEE 603, 10 CFR 50.55a

1. Introduction

The Nuclear Safety and Security Commission (NSSC) held its 2026-10th Meeting of the Commission on June 25th, 2026 to deliberate on and resolve the amended draft of NSSC Notice "Regulations on Safety Class and Class-specific Standards for Reactor Facilities" [1] which incorporates by reference the Institute of Electrical and Electronics Engineers (IEEE) Standard 603-2009, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations" [2]. The amendment reflects the revised industrial standards and the application limits (requirements that the regulatory body additionally requests when adopting industrial standards). The enactment and amendment will be finalized after administrative procedures, such as consultations with relevant agencies and the public announcement of the bill, are completed. In this paper, the amended draft of NSSC Notice, the major revision of IEEE 603-2009 compared to IEEE 603-1998 endorsed by NSSC notice, and the revision of 10 CFR 50.55a by US NRC on IEEE 603 are discussed.

2. Draft Amendment of NSSC Notice

2.1 Amended draft of NSSC Notice

According to the Article 9(Applicable Codes) of amended NSSC Notice "Regulations on Safety Class and Class-specific Standards for Reactor Facilities" the Safety Class-3 electrical equipment shall meet KEPIC ENA, ENB-1100, and ENB-6100 (editions and addenda from 2000 edition to 2019 addenda), or the equivalent IEEE 603 (1998, 2009 edition) and IEEE 279 (1971 edition). The major revision of the amended NSSC Notice is the incorporation of IEEE 603-2009 to the applicable code required for the design of safety I&C system in nuclear power plant.

2.2 Major Revision of IEEE 603-2009

The major revision of IEEE 603-2009 compared to IEEE 603-1998 includes: 1) deletion of referenced industry standards or changes to the applicable edition (e.g. ANSI/ANS 51.1 deleted, IEEE 379 edition revision), 2) revisions to term definitions (e.g. common-cause failure, associated circuit) and addition of notes, 3) additions or deletions to certain requirements (e.g. Section 5.6.3.1 - Interconnected equipment, Section 5.8.4 - Location). Section 5.6.3.1 of IEEE 603-2009 requires additional isolation criteria for the interconnected equipment such that isolation devices used to isolating interconnected equipment must ensure electrical isolation and digital communication independence. Section 5.8.4 of IEEE 603-2009 requires additional requirements regarding the location of information displays such that the basis for display locations should include functional task analysis results and accepted human factors considerations in accordance with IEEE 1023 and IEEE 497.

2.3 Regulatory applicability of IEEE 603-2009

Some examples of regulatory applicability for Korean NPPs regarding the major changes in IEEE 603-2009 are discussed in this section. Regarding the changes in Section 5.6.3.1 of IEEE 603-2009, the KINS/RG-N09.07 which endorses IEEE 384-2008 already requires physical separation, electrical isolation, and communication independence between safety and non-safety I&C and electrical systems. Regarding the changes in Section 5.8.4 of IEEE 603-2009, KINS/RG-N8.08 which endorses IEEE 497-2016 already requires displays for accident monitoring systems to minimize the possibility of ambiguous indications that could cause confusion to the operator.

The Shin-Hanul 3,4 NPPs which are the latest NPPs that received the construction permit (September 12, 2024) are designed to satisfy the additional requirements of IEEE 603-2009. To ensure independence among multiple 1E-class circuits within plant protection system and engineering safety equipment control system, the independence meets the separation requirements specified in IEEE 384 and IEEE 420. Especially, fiber-optic cables, which serve as electrical isolation devices, ensuring that even in the event of an electrical fault, they do not affect adjacent cables, are used for communication between channels in safety I&C systems of Shin-Hanul 3,4 NPPs. IEEE 497-2016 specifies in detail the selection criteria, performance criteria, design criteria, and verification criteria for accident monitoring variables, which are classified into types A, B, C, D, E, and F. The Type A, B, and C variables of Shin-Hanul 3,4 NPPs are designed so that a failure in an accident monitoring instrument channel does not cause confusion in the information to the extent that it prevents the operator

from performing the required safety-related functions or causes such a failure.

3. Incorporation of IEEE 603-2018 to 10 CFR 50.55a

The current requirements of the U.S. NRC, 10 CFR 50.55a "Codes and Standards" [3] and NRC RG 1.153 (Rev. 1, June 1991) approve IEEE 603-1991 and its correction sheet (1995) as applicable codes for safety I&C systems. The U.S. NRC recently published the federal register notice (90 FR 59402) which includes the proposed rule for 10 CFR 50.55a (NRC Docket#: NRC–2024–0045) and the draft of RG 1.153 Rev.2 [4] (DG-1251, Dec. 2025) to incorporate by reference of IEEE 603-2018. The major revision of IEEE 603-2018 includes the revised requirement for addressing common-cause failures (CCF) in safety I&C system (Section 5.16 – Common-cause failure). The Section 5.16 states the safety system design and development shall address CCF that create a potential to degrade or defeat the safety system function. The DG-1251 provides supplemental guidance and clarifying information for implementing certain criteria in IEEE Std 603-2018.

4. Conclusions

While the current regulation relies on the deterministic approach on safety I&C system design, Section 5.16 of IEEE 603-2018 adopts probabilistic approach in addressing CCF of safety I&C system such that the CCF has sufficiently low likelihood of occurring and the safety consequence that would result from the occurrence of the CCF in conjunction with any design basis event is low, such that public health and safety are maintained. KINS is currently reviewing whether IEEE 603-2018 is applicable code to safety I&C system considering Korean regulatory framework and will set regulatory position on IEEE 603-2018.

REFERENCES

[1] NSSC Notice "Regulations on Safety Class and Class-specific Standards for Reactor Facilities"
[2] IEEE 603 "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations "
[3] 10 CFR 50.55a "Codes and Standards"
[4] US NRC RG 1.153 Rev. 2 Draft (DG-1251) "Guidance for the Power, Instrumentation, and Control Portions of Safety Systems for Nuclear Power Plants"