



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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May 8, 2019

MEMORANDUM TO: Brian Thomas, Director
Division of Engineering
Office of Nuclear Reactor Research

FROM: Eric Benner, Director */RA/*
Division of Engineering
Office of Nuclear Regulatory Regulation

SUBJECT: RESULTS OF PERIODIC REVIEW OF REGULATORY GUIDE
1.152

This memorandum documents the U.S. Nuclear Regulatory Commission (NRC) periodic review of Regulatory Guide (RG) 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants." The periodic review was requested by your memorandum dated April 9, 2019. The review evaluation is enclosed.

RG 1.152 describes a method that the staff considers acceptable to implement the requirements, in part, of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(h); which incorporates by reference Institute of Electrical and Electronic Engineers (IEEE) Standard (Std) 279-1971¹ and IEEE Std 603-1991²; and 10 CFR Part 50, Appendix A General Design Criterion (GDC) 21, "Protection System Reliability and Testability," and Appendix B, Criterion III, "Design Control." RG 1.152, Revision 3 currently endorses the use of IEEE Std 7-4.3.2-2003, "Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations," with additional regulatory positions to provide guidance for establishing a secure development and operational environment (SDOE). However, this RG does not endorse the annexes in IEEE Std 7-4.3.2-2003, which provide informative criteria for topics such as identification and resolution of hazards and communication independence.

Based on results of the periodic review, a revision to RG 1.152, Revision 3, is warranted. The update to RG 1.152 is a high priority based on recent licensing experience and interactions with stakeholders on the IEEE Working Group that contributed to the update to IEEE Std 7-4.3.2 in 2016. RG 1.152 is one of the primary RGs used by applicants and licensees in the development of digital instrumentation and controls (I&C) license applications, reactor certifications, and digital I&C topical reports.

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¹ IEEE Std 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."

² IEEE Std 603-1991, "Criteria for Safety Systems for Nuclear Power Generating Stations."

The scope of IEEE Std 7-4.3.2-2003 only addresses computer based digital systems. The scope of updated IEEE Std 7-4.3.2-2016 has been expanded to also address programmable digital devices to encompass technologies, such as Field Programmable Gate Arrays (FPGAs), and includes criteria tailored to address the unique aspects of such technologies. This updated consensus standard also incorporates several criteria that staff currently uses in digital I&C Interim Staff Guidance (ISG)-04 "Highly Integrated Control Rooms – Communication Issues" for communications independence. The 2016 version of this standard also incorporates the regulatory positions for SDOE that is currently contained within RG 1.152 as additional guidance. Further, significant improvements have been made to Annex D, "Identification and Control of Hazards" within IEEE Std 7-4.3.2-2016. The staff anticipates that the RG can be simplified and IEEE Std 7-4-3.2-2016 may be endorsed with few exceptions and minimal clarifications.

In summary, endorsement of the latest version of IEEE Std 7-4.3.2 may facilitate licensees use of this RG in future license applications. To ensure consistency with other NRC digital I&C efforts, the update of RG 1.152, Revision 3 will be closely coordinated with broader digital I&C regulatory infrastructure improvement activities.

Enclosure:
As stated

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DATED: May 8, 2019

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Regulatory Guide Number: RG 1.152, Revision 3

Title: Results of Periodic Review of Regulatory Guide 1.152

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Staff Action Decided: Update to RG 1.152 is Warranted as High Priority

1. What are the known technical or regulatory issues with the current version of the Regulatory Guide (RG)?

The current RG is inefficient because it endorses the 15-year old IEEE Std 7-4.3.2-2003 and contains supplemental guidance on secure development and operational environments (SDOE). The current RG also does not incorporate detailed criteria from ISG-04 for addressing digital communication independence. Licensees are separately using the guidance within ISG-04 to address communications independence, which was meant only to be guidance for NRC staff. The RG also lacks guidance for hazard identification and controls and software-based development tools.

A newer version of IEEE Std 7-4.3.2 was issued in 2016 and reflects the latest science and industry consensus experience in digital Instrumental and Controls (I&C) implementation. It also (1) incorporates and addresses communication criteria from ISG-04 as appropriate for a licensee, (2) directly incorporates new guidance for SDOE; and (3) provides up to date guidance on hazard identification and software tools.

2. What is the impact on internal and external stakeholders of not updating the RG for the known issues, in terms of anticipated numbers of licensing and inspection activities over the next several years?

Licensees may not be able to efficiently take advantage of the latest approaches for addressing digital I&C technical issues that have been incorporated into the current version of IEEE Std 7.4-3-2-2016. This includes the updated informative annex on hazard identification and controls. The 2016 standard also includes improved guidance on the use of software-based tools during the development process. Currently, licensees have to address these topics with separate U.S. NRC guidance using the current RG and not endorsing IEEE Std 7-4.3.2-2016 creates inefficiencies in the industry use of this standard, and staff's licensing reviews.

Some developers intend to employ IEEE Std 7.4-3.2-2016 in new digital designs. The existence of out-of-date guidance, such as digital I&C ISG-04 and RG 1.152, Revision 3, results in misconceptions about the staff's current position on digital design criteria. This type of misconception may require interpretation or guesswork by designers, or cause reluctance by licensees in pursuing digital modifications. This has been identified by stakeholders as one type of unnecessary regulatory burden. In short, not updating the RG perpetuates this burden and contributes to growing regulatory uncertainty as digital

designs continue to evolve. This could result in fewer digital license applications and/or longer staff review periods.

3. What is an estimate of the level of effort needed to address identified issues in terms of full-time equivalent (FTE) and contractor resources?

Approximately 0.75 to 1.0 FTE. Contractor resources are not required.

4. Based on the answers to the questions above, what is the staff action for this guide

Based on the results of the periodic review, the staff concludes that a revision to RG 1.152, Revision 3 is warranted.

5. Provide a conceptual plan and timeframe to address the issues identified during the review.

The staff intends to develop a plan and schedule for updating the RG by June 15, 2019. The staff will notify industry stakeholders as part of our routine engagement within the Digital I&C Integrated Action Plan. Office of Nuclear Reactor Regulation staff does not currently plan to take exception to the current industry standard.

NRR will lead the development of the RG, and request assistance from the Office of Research for any required analyses of the proposed update. Completion of a draft RG for public comment is expected to take 6-9 months upon start, based on current resources and other digital I&C priorities.

NOTE: This review was conducted in May 2019 and reflects the staff's plans as of that date. These plans are tentative and subject to change.