

June 22, 2016

MEMORANDUM TO: Brian E. Thomas, Director  
Division of Engineering  
Office of Nuclear Regulatory Research

FROM: John W. Lubinski, Director */RA/*  
Division of Engineering  
Office of Nuclear Reactor 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 RG describes a method that the NRC staff deems acceptable for complying with the Commission's regulations for promoting high functional reliability, design quality, and a secure development and operational environment (SDOE) for the use of digital computers in the safety systems of nuclear power plants. In this context, the term "computer" identifies a system that includes computer hardware, software, firmware, and interfaces. The RG applies to all types of commercial nuclear power plants. As discussed in Management Directive 6.6, "Regulatory Guides," the NRC staff reviews RGs approximately every 5 years to ensure that the RGs continue to provide useful guidance. Documentation of the NRC staff review is enclosed.

Based on the results of the periodic review, the NRR staff concludes that a revision to RG 1.152 Revision 3 is warranted. The revision will include updating the endorsed consensus standards referenced in the RG to be consistent with the current revisions. In addition, new consensus standards may be included in the revision to provide guidance on alternative techniques not found in the RG. The revision may also include technical discussion by the staff regarding information obtained from reviewing licensing actions and operating experience from recent inspections and evaluations. The staff will develop a path forward for updating the RG in early 2017, in accordance with modernization plan number 4 of the DI&C integrated action plan. The path forward will be approved by the digital I&C management steering committee. The staff anticipates that a draft of Revision 4 of RG 1.152 could be developed and completed by the end of 2017 assuming timely resolution of associated issues described in the DI&C integrated action plan for this item.

Enclosure:  
As stated

CONTACT: Evan Davidson, NRR/DE  
301-415-1342

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## **Regulatory Guide Periodic Review**

**Regulatory Guide Number:** 1.152, Revision 3

**Title:** Criteria for Use of Computers in Safety Systems of Nuclear Power Plants

**Office/Division/Branch:** NRR/DE/XXX  
**Technical Lead:** XXXX

**Staff Action Decided:** Revise

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

Revision 3 of Regulatory Guide (RG) 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," describes a method that the NRC staff deems acceptable for complying with the Commission's regulations for promoting high functional reliability, design quality, and a secure development and operational environment for the use of digital computers in the safety systems of nuclear power plants. The RG applies to all types of commercial nuclear power plants.

The RG endorses the use of the Institute of Electrical and Electronics Engineers (IEEE) Standard 7-4.3.2-2003, "Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations," with some clarification and exceptions.

Many nuclear power plants were designed and built with analog instrumentation and control (I&C) systems. As analog I&C becomes obsolete, operating nuclear facilities are considering replacing these analog I&C safety systems with digital technology. Additionally, new reactors incorporate digital safety systems into their designs. Digital I&C technology has advantages, including automated monitoring and alerts for standby safety functions, and predictive algorithms to maintain critical safety systems. Digital I&C systems also present potential vulnerabilities that need to be assessed, including failures due to increased complexity of digital systems and the introduction of coding errors, common cause failure modes, and a limited operating history of digital systems in nuclear safety related applications. The NRC and industry stakeholders have identified the need to modernize the regulatory infrastructure to efficiently address risks associated with the introduction of digital technology for nuclear safety applications.

In Staff Requirements Memorandum (SRM) to SECY-15-0106, "Proposed Rule: Incorporation by Reference of Institute of Electrical and Electronics Engineers Standard 603-2009, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," the Commission directs the staff to develop an integrated strategy to modernize the NRC's digital I&C regulatory infrastructure. The NRC staff has prepared SECY-16-0070, "Integrated Strategy to Modernize the Nuclear Regulatory Commission's Digital Instrumentation and Control Regulatory Infrastructure," in response to the Commission's SRM. The SECY describes a strategy to modernize the NRC's regulatory infrastructure to enhance the agency's capability to determine whether there is

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reasonable assurance of safety and security in digital I&C systems for nuclear facilities. In developing the strategy, the staff considered the current regulatory infrastructure, ongoing regulatory activities, and stakeholder input to identify both short term and long term strategies.

Revision 3 of RG 1.152 is one of the documents that needs to be revised as part of the integrated digital I&C program.

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?**

The use of Revision 3 of RG 1.152 will have no known impact on internal or external stakeholders at this time. The 2009 version of IEEE Std. 603 includes additional guidance that should be part of the NRC staff review of license applications for advanced reactors and license renewal or modification requests for some facilities. Additionally, the NRC issued RIS 2016-05, "Embedded Digital Devices in Safety Related Systems," to heighten awareness of current regulatory requirements and technical positions for embedded digital devices.

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?**

The LOE needed for new RG 1.152 revision will require approximately 0.3 FTE for 1 year.

4. **Based on the answers to the questions above, what is the staff action for this guide (Reviewed with no issues identified, Reviewed with issues identified for future consideration, Revise, or Withdraw)?**

RG 1.152 has been reviewed and the RG should be revised to endorse, with some exceptions and clarifications, IEEE Std. 7-4.3.2-2010, "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations."

The additional specific requirements in IEEE Std. 7-4.3.2-2016 supplement the criteria and requirements of IEEE Std. 603-2009, "Criteria for Safety Systems for Nuclear Power Generating Stations," and are specified for programmable digital devices. Systems using these devices will be referred to as digital safety systems in the standard. The criteria contained in IEEE Std. 7-4.3.2-2016 in conjunction with criteria in IEEE Std. 603-2009 establish minimum functional and design requirements for programmable digital devices used as components of a safety system.

**NOTE: This review was conducted in June 2016 and reflects the staff's plans as of that date. These plans are tentative and are subject to change.**

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

The revision will include updating the endorsed consensus standards referenced in the RG to be consistent with the current revisions. In addition, new consensus standards may be included in the revision to provide guidance on alternative techniques not found in the RG. The revision may also include technical discussion by the staff regarding information obtained from reviewing licensing actions and operating experience from recent inspections and evaluations. The staff will develop a path forward for updating the RG in early 2017, in accordance with modernization plan number 4 of the DI&C integrated action plan. The path forward will be approved by the digital I&C management steering committee. The staff anticipates that a draft of Revision 4 of RG 1.152 could be developed and completed by the end of 2017 assuming timely resolution of associated issues described in the DI&C integrated action plan for this item.

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