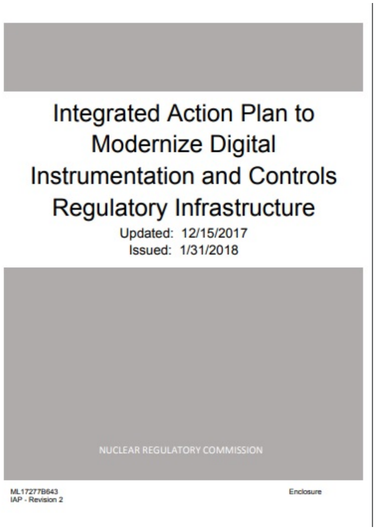
Integrated Action Plan For Digital I&C and Future Regulatory Modernization
- Panel -

11th Nuclear Plant Instrumentation, Control and Human-Machine Interface Technologies

Michael Waters, U.S. Nuclear Regulatory Commission



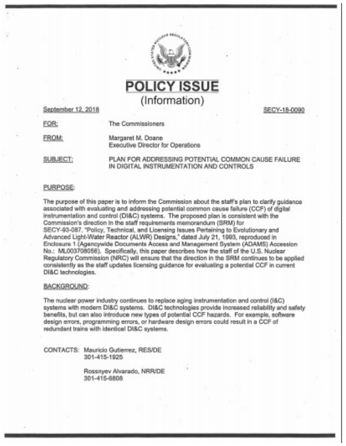
Integrated Action Plan to Modernize Digital Instrumentation and Controls Regulatory Infrastructure

Updated: 12/15/2017
Issued: 1/31/2018

NUCLEAR REGULATORY COMMISSION

ML17277B643
IAP - Revision 2

Enclosure



POLICY ISSUE
(Information)

September 12, 2018 SECY-18-0090

FOR: The Commissioners

FROM: Margaret M. Doane
Executive Director for Operations

SUBJECT: PLAN FOR ADDRESSING POTENTIAL COMMON CAUSE FAILURE IN DIGITAL INSTRUMENTATION AND CONTROLS

PURPOSE:

The purpose of this paper is to inform the Commission about the staff's plan to clarify guidance associated with evaluating and addressing potential common cause failure (CCF) of digital instrumentation and control (DI&C) systems. The proposed plan is consistent with the Commission's direction in the staff requirements memorandum (SRM) for SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," dated July 21, 1993, reproduced in Enclosure 1 (Agencywide Documents Access and Management System (ADAMS) Accession No.: ML003708056). Specifically, this paper describes how the staff of the U.S. Nuclear Regulatory Commission (NRC) will ensure that the direction in the SRM continues to be applied consistently as the staff updates licensing guidance for evaluating a potential CCF in current DI&C technologies.

BACKGROUND:

The nuclear power industry continues to replace aging instrumentation and control (I&C) systems with modern DI&C systems. DI&C technologies provide increased reliability and safety benefits, but can also introduce new types of potential CCF hazards. For example, software design errors, programming errors, or hardware design errors could result in a CCF of redundant trains with identical DI&C systems.

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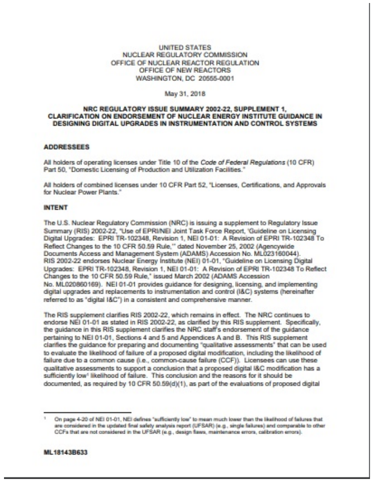

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF NEW REACTORS
WASHINGTON, DC 20555-0001

May 31, 2018

NRC REGULATORY ISSUE SUMMARY 2002-22, SUPPLEMENT 1, CLARIFICATION ON ENDORSEMENT OF NUCLEAR ENERGY INSTITUTE GUIDANCE IN DESIGNING DIGITAL UPGRADES IN INSTRUMENTATION AND CONTROL SYSTEMS

ADDRESSEES

All holders of operating licenses under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities."

All holders of combined licenses under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

INTENT

The U.S. Nuclear Regulatory Commission (NRC) is issuing a supplement to Regulatory Issue Summary (RIS) 2002-22, "Use of EPRI/NEI Joint Task Force Report, 'Guideline on Licensing Digital Upgrades: EPRI TR-102348, Revision 1, NEI 01-01: A Revision of EPRI TR-102348 To Reflect Changes to the 10 CFR 50.59 Rule,'" dated November 25, 2002 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML023160044). RIS 2002-22 endorses Nuclear Energy Institute (NEI) 01-01, "Guideline on Licensing Digital Upgrades: EPRI TR-102348, Revision 1, NEI 01-01: A Revision of EPRI TR-102348 To Reflect Changes to the 10 CFR 50.59 Rule," issued March 2002 (ADAMS Accession No. ML020860169). NEI 01-01 provides guidance for designing, licensing, and implementing digital upgrades and replacements to instrumentation and control (I&C) systems (hereinafter referred to as "digital I&C") in a consistent and comprehensive manner.

The RIS supplement clarifies RIS 2002-22, which remains in effect. The NRC continues to endorse NEI 01-01 as stated in RIS 2002-22, as clarified by this RIS supplement. Specifically, the guidance in this RIS supplement clarifies the NRC staff's endorsement of the guidance pertaining to NEI 01-01, Sections 4 and 5 and Appendices A and B. This RIS supplement clarifies the guidance for preparing and documenting "qualitative assessments" that can be used to evaluate the likelihood of failure of a proposed digital modification, including the likelihood of failure due to a common cause (i.e., common-cause failure (CCF)). Licensees can use these qualitative assessments to support a conclusion that a proposed digital I&C modification has a sufficiently low[1] likelihood of failure. This conclusion and the reasons for it should be documented, as required by 10 CFR 50.59(d)(1), as part of the evaluations of proposed digital

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[1] On page 4-20 of NEI 01-01, NEI defines "sufficiently low" to mean much lower than the likelihood of failures that are considered in the updated final safety analysis report (UFSAR) (e.g., single failures) and comparable to other CCFs that are not considered in the UFSAR (e.g., design flaws, maintenance errors, calibration errors).

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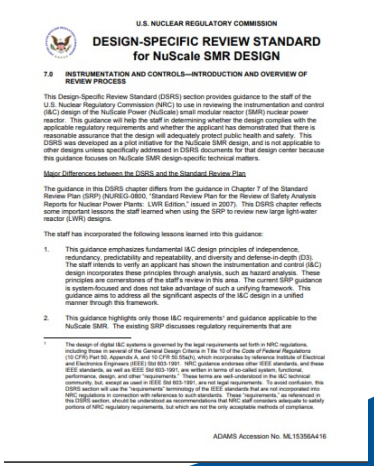

U.S. NUCLEAR REGULATORY COMMISSION

DESIGN-SPECIFIC REVIEW STANDARD for NuScale SMR DESIGN

7.0 INSTRUMENTATION AND CONTROLS—INTRODUCTION AND OVERVIEW OF REVIEW PROCESS

This Design-Specific Review Standard (DSRS) section provides guidance to the staff of the U.S. Nuclear Regulatory Commission (NRC) to use in reviewing the instrumentation and control (I&C) design of the NuScale Power (NuScale) small modular reactor (SMR) nuclear power reactor. This guidance will help the staff in determining whether the design complies with the applicable regulatory requirements and whether the applicant has demonstrated that there is reasonable assurance that the design will adequately protect public health and safety. This DSRS was developed as a pilot initiative for the NuScale SMR design, and is not applicable to other designs unless specifically addressed in DSRS documents for that design center because this guidance focuses on NuScale SMR design-specific technical matters.

Major Differences between the DSRS and the Standard Review Plan

The guidance in this DSRS chapter differs from the guidance in Chapter 7 of the Standard Review Plan (SRP) (NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," issued in 2007). This DSRS chapter reflects some important lessons the staff learned when using the SRP to review new large light-water reactor (LWR) designs.

The staff has incorporated the following lessons learned into this guidance:

1. This guidance emphasizes fundamental I&C design principles of independence, redundancy, predictability and repeatability, and diversity and defense-in-depth (D3). The staff intends to verify an applicant has shown the instrumentation and control (I&C) design incorporates these principles through analysis, such as hazard analysis. These principles are cornerstones of the staff's review in this area. The current SRP guidance is system-focused and does not take advantage of such a unifying framework. This guidance aims to address all the significant aspects of the I&C design in a unified manner through this framework.

2. This guidance highlights only those I&C requirements[1] and guidance applicable to the NuScale SMR. The existing SRP discusses regulatory requirements that are

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[1] The design of digital I&C systems is governed by the legal requirements set forth in NRC regulations, including those in several of the General Design Criteria in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, and 10 CFR 50.55a(h), which incorporates by reference Institute of Electrical and Electronics Engineers (IEEE) Std 603-1991. NRC guidance endorses other IEEE standards, and these IEEE standards, as well as IEEE Std 603-1991, are written in terms of so-called system, functional, performance, design, and other "requirements." These terms are well-understood in the I&C technical community, but, except as used in IEEE Std 603-1991, are not legal requirements. To avoid confusion, this DSRS section will use the "requirements" terminology of the IEEE standards that are not incorporated into NRC regulations in connection with references to such standards. These "requirements," as referenced in this DSRS section, should be understood as recommendations that NRC staff considers adequate to satisfy portions of NRC regulatory requirements, but which are not the only acceptable methods of compliance.

ADAMS Accession No. ML15356A416

Panel Discussion

- Opening Remarks
- Panel Discussion
- Audience Q & A

Panelists

- Ray Herb – Southern Nuclear
- Neil Archambo – Duke Energy
- Brian Gardes – NuScale Power
- Mark Burzynski – SunPort SA

NRC DI&C Integrated Action Plan (IAP)

(SECY-16-0070)

- Improve the regulatory infrastructure for Digital I&C
- Consider the broad context of DI&C regulatory challenges
- Address areas that have substantial near-term benefit
  - Treatment of Potential DI&C Common Cause Failure
  - Use of 50.59 for Digital Upgrades
  - Commercial Grade Dedication
  - Earlier Licensing Approval
- Consider long-term improvements to address broader regulatory challenges and evolving technologies

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

IAP Modernization Plans (MP)

- MP #1 Protection against Common Cause Failure (CCF)
- MP #2 Guidance for 10 CFR 50.59
- MP #3 Acceptance of Digital Equipment
- MP #4 Assessment for Modernizing I&C Regulatory Infrastructure

2018 Accomplishments

- Review of NRC CCF Policy (SECY-18-0060)
- NRC Guidance for Qualitatively Assessing Likelihood of Common Cause Failure in 50.59 Upgrades (Supplement 1 to RIS 2002-22)
- Industry Guidance for 50.59 Upgrades (Appendix D to NEI 96-07)
- NRC Guidance for Early Licensing of Major Digital Systems (DI&C ISG-06)
- Design Specific Review Guidance (NuScale DSRS)

NRC Guidance Activities in 2019

- Update to BTP 7-19 for Addressing Diversity and Defense in Depth for CCF
- Evaluation of IEC Standards as Alternatives to Meet the IEEE 279/603 Criteria in 10 CFR 50.55a(h)
- Endorsement Review of Commercial Grade Dedication Guidance
- Advanced Reactor Design Review Guidance
- Broad Assessment of Regulatory Infrastructure

Panel Discussion

- What are emergent challenges within the various digital I&C Communities?
  - U.S. Operating Reactor Fleet
  - New and Advanced Reactors
  - Research and Test Reactors
  - Digital I&C Vendors
  - International

- What are key industry guidance and research development initiatives?

- What are broader opportunities to transform the NRC regulatory framework?