

# Integrated Action Plan to Modernize Digital Instrumentation and Controls Regulatory Infrastructure

NUCLEAR REGULATORY COMMISSION

Enclosure 1

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# **Integrated Action Plan to Modernize Digital Instrumentation and Controls Regulatory Infrastructure**

## **Concurrence**

**ADAMS ACCESSION No:** ML16326A275:

\*concurrence via e-mail

<b>OFFICE</b>	<b>QTE*</b>	<b>NRR/DE/EICB</b>	<b>NRO/DE/ICE</b>	<b>NRO/DE/ICE</b>	<b>RES/DE/ICEEB</b>
<b>NAME</b>	JDougherty	RAIvarado	WMorton	DTaneja	BDittman
<b>DATE</b>					
<b>OFFICE</b>	<b>NRR/DPR/PLPB</b>	<b>NRR/DE/EICB</b>	<b>NRO/DE/ICE</b>	<b>RES/DE/ICEEB</b>	<b>OGC</b>
<b>NAME</b>	JDrake	MWaters	DCurtis	IJung	TCampbell
<b>DATE</b>					
<b>OFFICE</b>	<b>NMSS/FCSE</b>	<b>NSIR/CSD</b>	<b>RES/DE</b>	<b>NRO/DE/ICE</b>	<b>NRR/DE</b>
<b>NAME</b>	CErlanger	JAndersen	BThomas	MMayfield	JLubinski
<b>DATE</b>					

# **Integrated Action Plan to Modernize Digital Instrumentation and Controls Regulatory Infrastructure**

## **Summary**

This is an integrated action plan (IAP) that responds to Staff Requirements Memorandum (SRM) to SECY-15-0106<sup>1</sup>, “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,” which directs the staff to develop an integrated strategy to modernize the U.S. Nuclear Regulatory Commission’s (NRC’s) digital instrumentation and control (I&C) regulatory infrastructure. Consistent with Commission direction, this plan describes a strategy that engages external stakeholders to reach a common understanding of digital I&C regulatory challenges, priorities, and potential solutions to address them. The plan considers the broad context of digital I&C regulatory challenges and includes related activities being pursued by the staff. The plan was developed with NRC staff and external stakeholder input. In resolving the regulatory challenges, the plan provides for frequent public and stakeholder interactions. A senior management steering committee (SC) will oversee the resolution of digital I&C regulatory challenges identified within the plan. As the IAP is implemented and the modernization plans are accomplished, the staff will submit any recommended changes to NRC policies to the Commission.

As analog I&C becomes obsolete, operating nuclear facilities are considering replacing these analog I&C safety systems with digital technology. 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. . Many nuclear plants have applied digital technology to non-safety related applications including feedwater and turbine controls with a corresponding significant improvement in trip reduction. Digital I&C systems also present potential vulnerabilities that need to be assessed, including potential failures due to increased complexity of digital systems and the introduction of coding errors, common cause failure (CCF) modes, and limited operating history of digital systems in domestic 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.

The staff, in coordination with stakeholders, identified three key topics that would have the greatest impact, in the near-term, in addressing regulatory challenges and improving timeliness, efficiency, and effectiveness. The staff will prioritize and implement the complete set of regulatory activities, including building upon those in the first three key topics, needed to provide tactical regulatory clarity and support industry confidence to perform digital I&C upgrades.

The longer-term goal is to evaluate and implement the follow-on steps for continued improvement of the NRC’s digital I&C regulatory infrastructure. The infrastructure improvements will result in a state in which the nuclear power industry can perform digital upgrades under the 10 CFR 50.59 licensing process or, where necessary, obtain regulatory approval to use digital technology that provides for adequate safety and security through processes that are efficient, minimize uncertainty, and can be consistently applied across different technologies. The staff will review

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<sup>1</sup> Agencywide Documents Access and Management System (ADAMS) Accession No. ML16056A614.

and modify the current regulatory structure to be more performance-based and flexible by using new methods in the most effective way and updating the regulatory and guidance structure to acknowledge changes in the technology, the way it is developed, and how it is used. The staff will evaluate the results of implementation of the tactical activities and, with continued stakeholder interaction, will develop a performance-based, technology-neutral regulatory infrastructure that will anticipate the evolution and future development of digital I&C technology as it is applied to nuclear technologies.

For the longer-term items, the staff will identify actions needed to implement a simpler, streamlined and agile I&C regulatory infrastructure that will effectively address larger scale digital I&C upgrades and reduce the implementation risks by allowing NRC approval earlier in the process in a manner similar to new plant applications. This effort will also improve the clarity of the priorities and sequencing of further improvements with consideration of the objectives of transparency, regulatory stability and predictability, effective consideration of the cumulative effects of regulation, and efficient and effective use of limited NRC resources.

The staff has taken immediate action to develop a strategy to modernize the NRC's regulatory infrastructure. This strategy will also serve as a learning platform, to identify needs for future improvements in NRC's regulatory and guidance framework and acknowledge ongoing changes in the technology. Staff will engage the public and relevant stakeholders in the improvement of license reviews and other regulatory processes to develop a performance based, technology-neutral regulatory infrastructure.

The details of this plan describe an integrated strategy with tactical and strategic goals to modernize the regulatory infrastructure. Proposed changes include updating the regulatory requirements, policies, and guidance for digital I&C consistent with the Commission-directed attributes in SRM-SECY-15-0106 as listed below:

1. The plan should include the establishment of a senior management SC to oversee resolution of digital I&C regulatory challenges.
2. Any new or revised requirements addressed in the action plan should be performance-based rather than prescriptive.
3. Digital I&C safety requirements should be technology neutral, however, guidance should be tailored if necessary.
4. The same requirements should apply to operating and new reactors.
5. Guidance should focus on acceptable approaches to complying with requirements and may include specific technology focused provisions. If only one approach is acceptable to the staff to ensure safety based on current understanding, and this approach is appropriately technology-neutral and performance-based, then it should be included in a requirement rather than in guidance.
6. NRC requirements and guidance should not pose an unnecessary impediment to advancement in nuclear applications of digital technology.

This IAP is a living document. It will be updated based on progress made on related activities and modified, if necessary, based on Commission direction and new information.

## 1.0 Introduction

This document describes the staff's integrated action plan for modernizing the I&C regulatory infrastructure in response to SRM-SECY-15-0106. This integrated action plan will ensure safety and security while improving the predictability and consistency of the agency's regulatory process for licensing and oversight of digital I&C systems. This plan builds upon ongoing regulatory activities, stakeholder feedback concerning the previous draft versions of the action plan, and specific Commission direction in SRM-SECY-15-0106 to modernize the digital I&C regulatory infrastructure.

## 2.0 Background

In operating nuclear facilities, I&C equipment obsolescence is becoming significantly burdensome to licensees, and if not resolved, has the potential to impact the safety and security of operations. The implementation of digital technology in safety and security systems can be useful for resolving obsolescence issues, reducing uncertainties in the maintenance of plant safety, reducing opportunities for human error, reducing maintenance costs, and potentially improving safety. New nuclear facility designs being submitted for NRC licensing review incorporate modern, highly-integrated I&C design approaches. Such approaches and technology promise benefits to nuclear facility safety, security, and operation, including increased reliability and diagnostics and improved human-machine interfaces. Many industry stakeholders (i.e., licensees, applicants, and vendors) desire to take advantage of these potential safety and reliability benefits.

The NRC maintains a robust regulatory program for ensuring the safety and security of nuclear facilities protected and operated with analog and digital I&C systems.<sup>2</sup> Using its current regulatory infrastructure, the staff continues to review and approve license amendments for specific digital I&C systems, and evaluate new reactor applications that fully incorporate highly integrated digital technologies. To prepare for the review of applications for small modular reactor (SMR) design certifications and combined licenses, the staff has developed a design-specific review standard (DSRS). The DSRS reflects a number of important lessons the staff learned while using the Standard Review Plan (SRP) NUREG-0800 to review new large light water reactor designs. One of the lessons learned incorporated into this guidance emphasizes fundamental I&C design principles such as independence, redundancy, repeatability, predictability, the application of defensive measures (e.g. diversity, testing, etc.) and defense-in-depth, as derived through design and analysis, such as hazard analysis, to prevent loss or impairment of a safety function. This guidance addresses significant aspects of the I&C design in a unified manner.

The NRC provides oversight on the construction, implementation, use, and maintenance of digital I&C technologies that, directly or indirectly, could affect nuclear safety, and maintains an operational experience evaluation program to uncover any systemic issues with digital I&C systems. The staff updates its infrastructure (e.g., Regulatory Guides (RGs) and SRPs) to address new types of digital technologies and emergent regulatory issues in specific areas. The staff will continue to perform routine updates of RGs under normal processes, and perform various research activities to support emergent and strategic regulatory activities. This includes participation in consensus standards development activities (e.g., IEEE; International Society of Automation; American Nuclear Society; American National Standards Institute). The NRC is currently working to update RG 1.180, "Guidelines for Evaluating Electromagnetic and Radiofrequency Interference in Safety-Related Instrumentation and Control Systems," to endorse

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<sup>2</sup> This program was significantly improved in 2007 - 2011 when staff working groups, industry, and other stakeholders developed interim staff guidance to address digital I&C regulatory challenges at that time.

revised and new industry consensus standards addressing electromagnetic and radiofrequency interference qualification processes. The staff also conducts research to support development of the technical bases for future regulatory infrastructure improvements and emergent licensing challenges. For example, the NRC is currently performing key research activities in the area of digital system hazard analysis to be used in developing future regulatory guidance for evaluating digital safety systems. Such continued update and maintenance of the I&C regulatory infrastructure has helped the continued safe operation of reactors and materials facilities.

Some industry stakeholders have expressed concern that the current digital I&C licensing and oversight process for power and non-power reactors is cumbersome, inefficient, and/or unpredictable. Some have stated they are hesitant to pursue the deployment of digital I&C through license amendments, new applications, or changes under the Title 10 of the *Code of Federal Regulations* (10 CFR) 50.59 process, unless regulatory efficiency and predictability can be improved. As a result, the staff interacted with industry to discuss its concerns regarding these regulatory challenges. In response to these interactions and direction from the Commission, the staff developed an action plan to define specific regulatory challenges to be addressed and propose paths for resolving them. In January 2016, the NRC released its working version of this draft action plan (ADAMS Accession No. ML16014A085) to solicit feedback from stakeholders. The draft action plan described the staff's interpretation of several challenges to be addressed in response to stakeholder comments regarding their licensing and oversight experience in implementing digital I&C. The draft action plan also considered staff experience in evaluating digital safety system designs submitted as part of license applications or amendments, while implementing the interim staff guidance developed as a result of the 2007-2011 digital I&C project. The draft action plan identified key regulatory challenges and opportunities for improvement, including potential enhancements to policies, rules, guidance, practices, and processes in licensing and oversight.

On February 25, 2016, the Commission issued SRM-SECY-15-0106, which disapproved the staff's recommendation to publish for comment in the Federal Register a proposed rule which would incorporate by reference into 10 CFR 50.55a the IEEE Standard (Std.) 603-2009, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations." This proposed rule had included, along with the incorporation by reference of IEEE Std. 603-2009, additional conditions for addressing digital hazards analysis, independence, and digital communications. In the SRM, the Commission directed the staff to develop an integrated strategy, with proposed implementation milestones, to modernize the NRC's digital I&C regulatory infrastructure. In developing an integrated action plan, the Commission directed the staff to consider the broader context of digital I&C regulatory challenges and include all related activities being pursued by the staff including incorporation by reference of IEEE Std. 603-2009, updates to the policy on CCF in SRM-SECY-93-087, and development of guidance for 10 CFR 50.59 evaluations of digital I&C upgrades.

The Commission also directed the staff to engage in public workshops and meetings with the relevant IEEE standards setting committee, licensees, vendors, and other external stakeholders to reach a common understanding of the digital I&C regulatory challenges, priorities, and potential solutions to address them. The Commission also directed the development of the plan to be guided by the following principles:

- The staff's plan should include the establishment of a senior management SC to oversee resolution of digital I&C regulatory challenges.
- Any new or revised requirements addressed in the action plan should be performance-based rather than prescriptive.



- Digital I&C safety requirements should be technology neutral, however, guidance should be tailored if necessary.
- The same requirements should apply to operating and new reactors.
- Guidance should focus on acceptable approaches to complying with requirements and may include specific technology-focused provisions. If only one approach is acceptable to the staff to ensure safety based on current understanding, and this approach is appropriately technology neutral and performance-based, then it should be included in a requirement rather than in guidance.
- NRC requirements and guidance should not pose an unnecessary impediment to advancement in nuclear applications of digital technology.

### 3.0 Updating Processes for this Integrated Action Plan

The digital I&C SC was established to provide senior management oversight of the formulation of the strategy and execution of this action plan to modernize the digital I&C regulatory infrastructure. The SC is comprised of Division Directors with management responsibility for I&C technology in the Office of Nuclear Reactor Regulation (Chairperson), Office of New Reactors, and the Office of Nuclear Regulatory Research, and supplemented as needed with members from the Office of Nuclear Material Safety and Safeguards (NMSS) and the Office of Nuclear Security and Incident Response (NSIR). The SC ensures appropriate management focus on the resolution of regulatory issues and enhancement initiatives.

The SC will periodically assess the status and effectiveness of this integrated action plan consistent with the Commission direction in SRM-SECY-15-0106, and evaluate the progress of meeting the overall objectives of the modernization of the NRC's I&C regulatory infrastructure. The SC will be supported by managers and staff in the offices with expertise and shared responsibility in the field of digital I&C. This IAP will be implemented and updated by the respective NRC line organizations under the supervision of the SC. Ownership of each modernization plan will be assigned to appropriate NRC office leads. This integrated action plan will be updated semi-annually to indicate progress made within each activity, so that the document can also be used as a reporting/briefing tool. Changes to the modernization plans that are identified during these periodic reviews shall be agreed upon by the SC.

### 4.0 Summary of Changes

Page(s)	Revision	Change	Reason for Change
All	1	Incorporation of NEI comments (12/2/16).	Industry stakeholder engagement.
All	1	Editorial updates.	Completeness.
8	1	Added Section 4.0 "Summary of Changes". Renumbered subsequent sections.	Record keeping.
11-17	1	MP#1 strategy and scheduling updated.	Incorporates industry feedback and steering committee directives.
18-20	1	MP#2 strategy and scheduling updated.	Incorporates industry feedback and steering committee directives.
21-24	1	MP#3 strategy and scheduling updated.	Incorporates industry feedback and steering committee directives.

## 5.0 Detailed Modernization Plans

The following four Modernization Plans (MPs) will be used to resolve regulatory challenges, provide confidence to licensees, and modernize the I&C regulatory infrastructure. Detailed plans have been developed for each activity. These activities are inter-related and the NRC working groups will ensure integration and coordination on common issues.

1. **Protection Against Common Cause Failures.** This modernization plan addresses developing guidance for using coping analysis for addressing CCF, use of defensive measures for eliminating CCF from further consideration, and staff evaluation of the NRC's existing positions on defense against CCF. The NRC's current position on CCF is guided by SRM-SECY-93-087 and SRP-BTP-7-19. The NRC's current position does not include specific criteria to eliminate the potential of software CCF from consideration in a defense-in-depth and diversity analysis. Furthermore, the current guidance is not clear about the criteria for using coping analysis and defensive measures for eliminating CCF from further consideration. The NRC staff will develop guidance to provide additions and/or clarifications to the digital I&C CCF technical evaluation processes for staff and licensees to follow when implementing or updating digital auxiliary and support I&C systems (e.g., chillers). In addition, the NRC staff will assess the current NRC position on potential CCF to ensure safety and security while enhancing efficiency, clarity, and confidence in determining the potential for CCF in the analysis of digital I&C systems. This last activity will examine the technical basis to evaluate a graded approach based on safety significance, including consideration of the likelihood of CCF and a risk-informed, consequence based regulatory structure. This will include examination of state-of-the-art analysis in other digital I&C applications, such as other industries and from other countries.
2. **Considering Digital Instrument & Control in accordance with 10 CFR 50.59.** This activity addresses the need for clarity of mutual industry and staff understanding that NRC guidance is being properly translated into industry actions for performing 10 CFR 50.59 evaluations of digital I&C plant modifications. Under existing guidance for the 10 CFR 50.59 screening and evaluation of digital I&C systems, several licensees have improperly performed 10 CFR 50.59 analyses for modifications of I&C systems using digital technologies. Industry stakeholders have stated they are hesitant to pursue the deployment of digital I&C upgrades through changes under the 10 CFR 50.59 process because of regulatory uncertainty. The objective of this effort is to ensure there is adequate guidance with sufficient clarity for staff and stakeholder understanding of 10 CFR 50.59 evaluations of digital I&C upgrades.
3. **Commercial Grade Dedication of Digital Equipment.** This activity will support improved guidance for commercial grade dedication (CGD) of digital equipment. Many digital I&C and other digital equipment that is readily available in the marketplace was not designed specifically for use in nuclear facilities and has not been designed, developed, and fabricated in accordance with NRC quality assurance criteria (as defined in Appendix B to 10 CFR Part 50). This plan provides activities intended to evaluate the suitability of additional guidance and industry standards and determine if the NRC will evaluate whether it should endorse standards for the purpose of defining critical characteristics of commercial grade items (CGI) and the mechanism by which they are verified. The staff is currently updating guidance for reviewing CGD, including specific reference to digital

equipment. The staff will engage with stakeholders to better understand current challenges, potential benefits, and evaluate recommended solutions concerning CGD.

4. **Modernization of the Instrument & Control Regulatory Infrastructure.** The objective of this effort is to perform a comprehensive modernization assessment to identify further improvements to the regulatory infrastructure (regulations and guidance) and develop plans for accomplishing such improvements. The staff will assess progress on the first three MPs in the action plan and the list of topics provided in Appendix A of this plan to determine the appropriate sequencing of activities based on meeting the following key objectives:

- A. Prioritize and implement the complete set of regulatory activities, including building upon those in the first three MPs, needed to provide tactical regulatory clarity and support industry confidence to perform digital I&C upgrades. These activities will include but may not be limited to: a) implementing an updated CCF position into technical guidance for use both in concert with endorsed 10 CFR 50.59 change authority guidance and additional licensing guidance improvements, b) improving licensing guidance including evaluating lessons learned from review of license applications, including factory acceptance testing and scope of supporting application material, c) developing inspection guidance for digital I&C upgrades performed under 10 CFR 50.59 and license application approvals.

The staff has initially identified these additional topic areas as being necessary to meet objective 4A and will seek stakeholder feedback in identifying the complete list of activities from its review of all activities listed in Appendix A. The staff will develop detailed schedules for additional, high-priority tactical topics during the comprehensive modernization assessment.

The staff will implement revised guidance to improve the efficiency of the license application review process. Also the staff will work with industry stakeholders to identify efficiency metrics for new application reviews.

- B. Identify actions needed to implement a simpler, streamlined, and agile I&C regulatory infrastructure that will ensure safety and security while effectively addressing larger scale digital I&C upgrades to operating reactors and the I&C designs for new and advanced reactors. The outcome will also improve clarity regarding the interrelationships between the regulatory issues, the priorities and sequencing of further improvements, and the supporting research that is needed to accomplish such improvements to meet both objectives.

Completion of the modernization efforts will ensure safety and security and result in greater regulatory efficiency, predictability, and agility in addressing strategic digital I&C applications by the nuclear industry. Both the tactical and strategic goals of the IAP involves the development of technical bases to support resolution of identified technical issues. The development of the technical basis to support the comprehensive modernization activities in MP #4B will likely require relatively greater research activities.

## **MP #1. Protection Against Common Cause Failure**

### Introduction

This modernization plan describes the activities and schedule for addressing methods for evaluating the potential for common cause failure (CCF), which could lead to safety-significant consequences. The occurrence of CCF can compromise functional independence across redundant channels or divisions, across echelons of defense, across operator displays and monitored elements, and other layers of defense. As part of modernizing the NRC's digital I&C regulatory infrastructure, the staff is evaluating the NRC's existing positions on acceptable defenses against CCF within digital I&C systems and measures that can be applied to prevent, or mitigate against postulated CCF events occurring within digital I&C safety systems.

### Background

The Commission provided its current direction to the staff regarding protection against CCF in Digital I&C systems in its Staff Requirements Memorandum SRM-SECY-93-087 item II.Q. The SRM provides specific acceptance criteria for the evaluation of CCF, which the staff implemented in Standard Review Plan NUREG-0800, Chapter 7, and Branch Technical Position BTP-7-19. Item II.Q of the SRM includes the following position: "The applicant shall assess the defense-in-depth and diversity of the proposed instrumentation and control system to demonstrate that vulnerabilities to common mode failures have adequately been addressed." The intent behind the application of the defense-in-depth and diversity (D3) philosophy in digital I&C safety systems is to protect against residual unknowns (beyond design basis) such as latent engineering development (including software) deficiencies. The SRM-SECY-93-087 does not specify the criteria which must be evaluated to eliminate from further consideration the potential of a latent software deficiency in a defense-in-depth and diversity analysis. However, the staff review guidance in BTP 7-19 includes two criteria, which, if satisfied, can be used to eliminate from further consideration the potential for software CCF, based on a demonstration that adequate internal diversity exists, or based on assurance that the systems are sufficiently simple that all possible software failure paths can be tested for and shown to be non-existent. The staff's position was last enunciated to the Commission in SECY-09-0061, "Status of the Nuclear Regulatory Commission Staff Efforts to Improve the Predictability and Effectiveness of Digital Instrumentation and Control Reviews" (ADAMS Accession No. ML090790409).

Representatives of the nuclear industry (hereinafter referred to as "industry") have stated that the current digital I&C licensing and oversight process for power and non-power reactors is cumbersome, inefficient, and/or unpredictable. In particular, they have suggested the current guidance to perform I&C modification has insufficient details regarding: a) how to address the potential for CCF (e.g., potential plant vulnerabilities from having identical redundant digital I&C divisions, or mistakes made or errors introduced by processes for implementing configuration changes); b) how to acceptably analyze the potential for CCF for its safety impact; and c) how this analysis may be acceptably used in licensing activities. Further, licensees have stated that the current regulatory treatment and acceptance criteria dealing with the potential for CCF in the analysis of digital I&C systems has been problematic. Specifically, they have stated that the proper application of the screening criteria for "simple systems" in SRP-BTP 7-19 regarding 100% testability, and the lack of a graded approach based on safety significance, place a high burden for demonstrating that adequate digital I&C system development processes have been employed - especially for systems containing localized embedded digital I&C components. Therefore, the resolution of CCF concerns is the lead technical issue and a critical enabler for addressing other

issues related to digital I&C. Industry stakeholders are looking for clearer NRC staff guidance on methods for analysis of the potential for CCF of digital I&C systems. In addition, industry is seeking a more risk-informed, consequence-based regulatory infrastructure that removes uncertainty, ambiguity, and overlap in requirements and enables technical consistency.

In April 2016, industry submitted its comments to the draft digital I&C integrated action plan (IAP) which included recommendations to resolve CCF concerns. Industry agrees with the staff that review of the CCF concerns is a high-priority regulatory issue. In its recommendations, industry proposed use of and greater reliance upon development practices and deterministic defensive measures within digital I&C systems to minimize the impact of potential CCF. Specifically, they suggested the staff credit development practices and deterministic defensive measures within digital I&C systems that play a part in assuring that CCF will be unlikely. The staff plans to evaluate the industry-proposed technical basis for application of such development practices and defensive measures to ascertain how the effectiveness of applying such measures may be assessed, and whether the criteria and methodology for crediting them can be consistently applied by suitably qualified I&C engineers. Also, industry recommended the use of previous plant licensing basis analyses to demonstrate that the consequences of a potential CCF is bounded. The staff will consider the recommendations proposed by industry as part of the broader effort to develop a technical basis evaluating the current NRC position and evaluation of the alternatives available to resolve CCF concerns.

#### Evaluation of Efforts (June – December 2016)

The staff has engaged on multiple occasions with NEI and public stakeholders to gather information on key technical and policy issues and has conducted table-top exercises. The staff has identified areas for improvement within BTP 7-19 from these interactions.

#### Public meetings held:

Title	Date	ADAMS ML#
Public Meeting	March 21, 2016	ML16068A092
Public Meeting	June 7, 2016	ML16082A142
Common Cause Failure NEI Table Top	July 11, 2016	ML16174A045
Common Cause Failure NEI Table Top	August 22, 2016	ML16174A049
Public Meeting	September 14, 2016	ML16264A340
Public Meeting	December 1, 2016	ML16320A034

Based on the discussions held in the above public meetings, the NRC staff has made tactical adjustments to MP #1 to address an industry identified need for staff to provide the technical and licensing actions needed to install or modify digital upgrades to auxiliary and support I&C systems (e.g., chillers). The NRC staff is currently developing guidance to perform and use coping analysis to address CCF. The NRC staff drafted proposed definitions for coping and bounding analyses to address CCF, so these analyses can support responses to evaluation questions for modifications or replacement of digital auxiliary or support I&C systems (e.g., chillers) using the 10 CFR 50.59 process. This information was presented to NEI and industry during the December 1, 2016, meeting.

NEI is developing guidance document NEI 16-16 to provide the industry position on additional methods for assessing the susceptibility of a proposed digital I&C system design to common

cause failures, and making a determination as to whether the potential for such CCF can be considered as not credible. NEI provided a partial draft of NEI 16-16 on December 22, 2016. In its current form, NEI 16-16 is intended to address CCF for all types of systems (e.g., protection systems, engineered safety feature systems<sup>3</sup>, and plant auxiliary systems, such as Control Room HVAC chiller system controls), and does not contain risk insights. NEI 16-16 also provides a recommended framework and methodology and will address topics including scope, applicability, analysis methods to determine CCF susceptibility, coping and bounding, and defensive measures that may be enacted to sufficiently reduce the likelihood, limit and/or prevent a potential CCF from occurring.

To facilitate the staff's evaluation of NEI 16-16, the staff is examining the range of digital I&C CCF consequences that are possible, depending on risk significance. An attempt is being made to define a risk-based threshold, above which the performance of a formal D3 analysis per BTP 7-19 and NUREG/CR-6303 is considered mandatory per the Commission SRM direction, and below which, the performance of a rigorous digital I&C engineering development process (to be identified as part of this activity), in conjunction with application-specific factors, could be considered adequate to assure that plant operators have the capability to manage digital I&C failures due to software CCF without challenging the conclusions in the plant design basis safety analysis.

### Objectives

The objectives of MP1 are to:

- A. Produce Interim Staff Guidance (ISG) to evaluate industry's proposed use of coping analysis to address CCF when replacing or modifying lower risk-significant safety system auxiliary and/or support digital I&C systems (e.g., chiller control systems). This ISG will not address protection systems or I&C-based engineered safety features systems. This ISG will identify possible revisions, additions and/or clarifications to the current digital I&C CCF technical evaluation processes for staff and licensees. The NRC staff will consider information from NEI 16-16 regarding coping analysis (provided in Section 4.2 in NEI 16-16) to develop this guidance. This guidance will include provisions for using and reviewing the results of coping analyses when performing 10 CFR 50.59 evaluations.
- B. Evaluate NEI's proposed guidance in NEI 16-16 for assessing the qualitative likelihood of common cause failure in digital I&C systems, based on the application of key design measures for preventing, limiting, or mitigating CCF that are to be incorporated during the development process. NRC staff will evaluate the industry proposal to use such defensive design measures, as described in NEI 16-16, to ascertain whether there is adequate technical justification to preclude the need for performance of a D3 analysis to guard against potential CCF for lower risk-significant applications. The staff will evaluate the possibility for use of a graded approach based on the risk-significance of potential CCF. The staff will consider possible endorsement of NEI 16-16 to the extent practical for RPS, Engineered Safety Features, auxiliary, supporting, and/or non-safety DI&C systems, if sufficient technical basis exists. If industry's proposal is deemed technically acceptable and provides reasonable assurance of adequate protection, the NRC staff will develop a document to convey its endorsement, in whole or in part, of the NEI 16-16

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<sup>3</sup> Systems that prevent and/or mitigate the consequences of potential transients and accidents described in the Final Safety Analysis Report including the bounding design basis accidents.

guidance.

- C. Evaluate the need to modify NRC's current position on protection of DI&C systems and components against CCF. This evaluation will include: (1) a clarification of the scope of systems intended to be addressed under the position; (2) examination of the technical acceptability for using a graded approach based on risk significance or safety significance. The results of activities completed while addressing MP1 Objectives A & B will be included with the results of the staff's examination of the NRC's current position, to provide input into and be summarized in a technical basis document to support staff recommendations (SECY paper) to the Commission.

Guidance in BTP 7-19 will be updated to reflect the results from these evaluations and Commission direction. Successful realization of these objectives should serve to improve the ability of NRC staff and industry to determine the acceptability of a proposed design or modification in a digital safety system (including components) evaluated through an NRC license amendment application (10 CFR 50.90) or change under 10 CFR 50.59.

### Actions

The NRC staff will engage industry through workshops and public meetings to discuss its findings and refine the project plan as needed. As part of the activities below, the staff will take into consideration applicable information within NEI 16-16 in developing relevant guidance. NEI 16-16 describes a proposed comprehensive range of CCF assessment methods. The industry acknowledges that the document may be segmented to allow agreement on certain topics (e.g. scope, coping analysis, and bounded results) in the near term while other topics (e.g. design measures that result in reasonable assurance of adequate protection against a potential CCF) may be evaluated over a longer term schedule. In addition, once finalized, NEI intends to submit NEI 16-16 for NRC's potential approval and endorsement.

Activities for Each Objective		Schedule
<b>A. Guidance to perform and use coping analysis to address CCF</b>		
A.1	Discuss NRC approach and definitions with NEI and industry	December 2016
A.2	Receive partial draft NEI 16-16	December 2016
A.3	Consider Draft NEI-16-16, section on "Analysis of CCF Malfunction"	January 2017
A.4	Review guidance in BTP 7-19 and other guidance for addressing CCF	January 2017
A.5	Receive formal NEI 16-16 submission from NEI	March 2017
A.6	Develop internal draft ISG for addressing CCF using coping analysis	March 2017
A.7	Discuss proposed approach with I&C staff	March 2017
A.8	Provide draft ISG and engage NEI and industry	April 2017
A.9	Engage with I&C Steering Committee	May 2017
A.10	Issue draft ISG for public comment and address public comments	June 2017
A.11	Present to ACRS	June 2017
A.12	Issue draft guidance	July 2017

<b>B. Evaluation of NEI 16-16 with respect to guidance to address “credible” common cause failures via use of defensive measures.</b>		
B.1	Begin staff evaluation of the partial draft of NEI 16-16 received 12/22/2016 and develop staff comments/gap analysis	December 2016
B.2	Meet with NEI and industry to discuss NEI’s plans for completion of CCF likelihood technical basis, associated defensive measures, Appendices, and the balance of NEI 16-16 content	February 8-9 2017
B.3	NEI to deliver the remaining portions of NEI 16-16, including technical basis, examples, and Appendices.	Assumption to be Confirmed: March 31 2017 <sup>4</sup>
B.4	Meet with NEI and industry to discuss methodology and technical basis	As-needed March – July 2017
B.5	Complete staff review of NEI 16-16, and make determination as to its “endorse-ability” or partial “endorse-ability.”	August 2017
B.6	Periodically update I&C staff members of observations and conclusions	April - July 2017
B.7	Develop a draft staff evaluation of NEI 16-16	September 2017
B.8	Engage with NEI, Industry, I&C Steering Committee	As-needed
B.9	Issue NRC Management’s letter of intent to endorse acceptable portions of NEI 16-16 pending resolution of open items	September 2017
B.10	Present to ACRS	October – November 2017
B.11	Initiate development document to communicate staff decision on endorsement, partial endorsement, or rejection of NEI 16-16	January 2018
<b>C. Evaluate the need to modify NRC’s current position on defense against CCF in DI&amp;C systems and components</b>		
C.1	Begin staff review to identify specific aspects of NRC’s position on CCF and communicate any policy issues that need to be modified. Meet with DI&C Steering Committee and other stakeholders as needed.	March-July 2017
C.2	Finalize list of specific aspects of NRC’s position on CCF that are impacted by the industry’s approach as proposed in NEI 16-16.	August 2017
C.3	Engage NEI, industry stakeholders, DI&C Steering Committee	September 2017
C.4	Decide on need to affirm or modify NRC’s position on defense against CCF in DI&C systems and components.	October 2017
C.5	Produce technical basis document to support affirmation or modification of NRC’s position.	TBD
C.6	Engage outside peer reviewer to assess staff’s findings.	TBD
C.7	Solicit and disposition public comments	TBD
C.8	Present to ACRS	TBD

<sup>4</sup> This a key date. If this milestone date is not achieved by NEI, the dates for activities B.4 through B.11 and C.1 through C.10 will need to be adjusted to account for the number of months this milestone date has slipped.



C.9	Submit SECY paper (with technical basis document) identifying proposed action to modify or affirm existing position to the Commission.	TBD
C.10	Implement resolution as determined by the Commission.	TBD
C.11	Revise BTP 7-19 for consistency with Commission decision.	TBD

Meetings will be scheduled based on completion of deliverables or milestones agreed upon. In addition, the draft guidance document(s) to be developed to address the activities under Objectives A and B, will be made public for a public comment period of 30 days each time.

In addition, this schedule includes producing the technical basis document supporting the staff's recommendations to the Commission (SECY paper) and making it available for a public comment period of 30 days, in addition to engagement with the public during the development of the technical basis. The public comment period will start as soon as practical after the technical basis document is complete. The staff will also request review of its technical basis by a diverse set of outside technical experts. This review will be performed in parallel with the public comment period.

#### Status

(As of February 9, 2017)

The staff continues to have public meetings with NEI and external stakeholders. NRC and industry have agreed to establish high priority to the completion of activities for Objective A, with the Activities for Objectives B and C to follow as soon as practical thereafter.

At a December 2016 public meeting, the NRC staff presented its proposed approach for defining coping analysis for addressing CCF. In addition, NEI submitted a draft version of NEI 16-16 in December 2016 to support staff development of guidance to address CCF. A meeting was held in early February 2017 to discuss the staff's progress in developing the ISG on coping, and NEI's progress in developing a technical basis for the methodology described within NEI 16-16.

The portion of the MP#1 CCF working group responsible for achieving the objectives in MP#1A is coordinating with the MP#2 working group responsible for developing guidance for addressing incorporation of digital I&C under the 10 CFR 50.59 design change evaluation process, such that the CCF coping guidance being developed is compatible with proposed guidance for performing 10 CFR 50.59 evaluations.

#### Potential Regulatory Challenges and Policy Issues

Any change or affirmation of the current NRC CCF position is considered to be a potential policy issue that is to be coordinated with the Commission. The staff will prepare a SECY paper with an accompanying technical basis paper describing staff's recommendation. The staff will also consult with the Commission if any additional potential policy issues relevant to CCF are identified when implementing this activity.

- Potential actions for addressing CCF issues will have to be informed by consideration of backfitting, regulatory analysis, and cumulative effects of regulation.
- Staff actions will be impacted if industry does not participate or is untimely with its deliverables as described in the above activities.

#### Interactions with other Action Plan Items

CCF of digital I&C systems is an important aspect supporting the working group responsible for improving licensee guidance for replacing or modifying digital I&C using the 10 CFR 50.59 process (MP #2). In particular, the guidance being developed in Activities A to address CCF in digital auxiliary and support systems (e.g., chillers) requires close coordination with MP#2.

Implementation of the resolution of CCF as identified in the SECY paper will be addressed as in objective (A) of MP #4.

## **MP #2. Considering Digital Instrumental & Control in Accordance with 10 CFR 50.59**

### Introduction

This action plan describes the activities and schedule for improving guidance regarding digital I&C modifications using the 10 CFR 50.59 change process. These activities will address the need for mutual clarity between industry and NRC staff to ensure NRC guidance is being properly translated into industry actions while performing 10 CFR 50.59 screening and evaluations potential digital I&C plant modifications. This action plan applies to operating reactors, new reactors, non-power production, and utilization facilities (e.g., research and test reactors and medical isotope processing facilities). Overall, the goals of these actions is to reduce licensing uncertainty and provide clarity on the regulatory process.

NRC intends to evaluate current and proposed guidance for the licensing criteria in 10 CFR and schedule of this review. MP #1 describes the plan for evaluating and updating the NRC position on CCF, which may lead to future updated guidance on accepted technical methodologies applicable to 10 CFR 50.59 evaluations. MP# 4 describes the plan for evaluating additional regulatory infrastructure activities such as technical guidance development, integrating progress that is made on this activity and CCF (MP #1).

### Background

Inadequate guidance for the 10 CFR 50.59 screening and evaluation of digital I&C systems has contributed to several licensees having improperly performed 10 CFR 50.59 analyses for modifications of I&C systems using digital technologies. The current guidance addresses both 10 CFR 50.59 licensing positions and technical methodologies, which has resulted in ambiguity on key evaluation issues such as CCF in digital modifications. The staff held several public meetings with industry representatives on this subject, and indicated where the industry guidance should be improved. Industry representatives stated that they are hesitant to pursue the deployment of digital I&C upgrades through changes under the 10 CFR 50.59 process because of regulatory uncertainty and a lack of clarity in the regulatory process.

RG 1.187, "Guidance for Implementation of 10 CFR 50.59, Changes, Tests, and Experiments," provides the staff's endorsement of industry guidance for evaluating the impact on plant safety analyses for plant modifications performed under 10 CFR 50.59. The objectives of 10 CFR 50.59 are to ensure that licensees: (1) evaluate proposed changes to their facilities for their effects on the licensing basis of the plant, as described in their updated final safety analysis report, and (2) obtain prior NRC approval for changes that meet specified criteria as having a potential impact upon the plant license basis. RG 1.187 endorsed Revision 1 of NEI 96-07, "Guidelines for 10 CFR 50.59 Evaluation," dated November 2000, which provides methods that are acceptable to the NRC staff for complying with the provision of 10 CFR 50.59.

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,' " provides the NRC staff's endorsement for the use of NEI 01-01<sup>5</sup>. However, experience with implementing digital I&C upgrades under 10 CFR 50.59 at nuclear facilities has revealed several shortfalls in the screening of modifications, addressing the appropriate design criteria, and evaluating the impact of proposed digital I&C on established licensing basis. A key issue identified as a result of recent oversight experience has

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<sup>5</sup> ADAMS Accession No. ML020860169

been licensee assessment of potential CCF and any potential new malfunctions, with respect to addressing the specific criteria in 10 CFR 50.59(c)(2).

In a November 2013 letter to the Nuclear Energy Institute (NEI) (ADAMS Accession No. ML13298A787), the staff summarized its concerns regarding licensee implementation of the current guidance in NEI 01-01. In response, NEI formed a working group to update its guidance for implementing digital I&C modifications under 10 CFR 50.59. The NEI working group found that additional guidance was needed to support certain aspects of evaluating the impact of such modifications on plant safety.

In April 2016, NEI provided draft Appendix D to NEI 96-07 for digital modifications. NEI requested NRC endorsement of the appendix through a new regulatory guide, separate of RG 1.187. NEI has stated that draft Appendix D is only focused on evaluating the specific licensing criteria in 10 CFR 50.59 for digital I&C, and not the supporting technical methodologies for addressing CCF and failure likelihoods. NRC endorsed technical methods and associated regulatory positions are addressed in other existing regulatory documents. NEI is therefore not providing or referencing any technical methodologies in Appendix D. NEI recognizes that the NRC position on CCF will be updated separately as part of MP #1.

### Objectives

The objective is to ensure there is adequate guidance for 10 CFR 50.59 evaluations of digital I&C upgrades in order to reduce licensing uncertainty and clarify the regulatory process. The NRC is evaluating draft Appendix D to NEI 96-07 for possible endorsement in NRC regulatory guidance to supersede its endorsement of NEI 01-01. Specifically, the goal is to address legacy issues identified with current guidance and provide additional licensing flexibilities to industry when considering CCF under 10 CFR 50.59.

### Actions

<b>Activity</b>	<b>Schedule</b>
1. Receive NEI guidance document, Appendix D 96-07, Guidelines for 10 CFR 50.59 Evaluations.	April 4, 2016 (c)
2. Conduct public meeting: NEI presented the guidance in Appendix D and engaged with NRC staff discussion.	April 28, 2016 (c)
3. Complete initial review of Appendix D and provide general comments to NEI.	August 2016 (c)
4. Finalize Draft NEI 96-07 Appendix D, "Definitions" Section	November 2016 (c)
5. Finalize Draft NEI 96-07 Appendix D, "Introduction" Section	2 <sup>nd</sup> Qtr. CY 2017
6. Provide formal comments on Draft NEI 96-07 Appendix D, "Screen Guidance" Section	March 17 <sup>th</sup> , 2017
7. Finalize Draft NEI 96-07 Appendix D "Screen Guidance"	2 <sup>nd</sup> Qtr. CY 2017
8. Receive revised Draft NEI 96-07 Appendix D, "Evaluation Guidance" Section for review	February 17, 2017
9. Finalize Draft NEI 96-07 Appendix D, Section 4.0, "Evaluation Guidance" Section	2 <sup>nd</sup> Qtr. CY 2017
10. Finalize Draft NEI 96-07 Appendix D, Section 5.0, "Examples"	2 <sup>nd</sup> Qtr. CY 2017
11. ACRS Meeting on Draft NEI 96-07 Appendix D	May 18 <sup>th</sup> , 2017
12. Conduct table top exercise with industry using the revised Appendix D to verify the new guidance is clear and consistent.	3 <sup>rd</sup> Qtr. CY 2017

<b>Activity</b>	<b>Schedule</b>
13. Decide on appropriateness of issuing interim endorsement letter, and issue letter, if appropriate.	3 <sup>rd</sup> Qtr. CY 2017
14. Begin update of regulatory guidance.	4 <sup>th</sup> Qtr. CY 2017

#### Status

(As of January 06, 2017)

Staff review of draft NEI 96-07, Revision 1, Appendix D is still ongoing. Staff and industry participated in public meetings throughout 2016, and starting in September 2016, began meeting on a monthly basis to quicken the pace of guidance development and review. Staff is working with industry to develop content to be entered into Appendix D to account for legacy issues with current guidance (i.e. NEI 01-01) as well as provide licensees more flexibility when considering SWCCF under 10 CFR 50.59 to reduce licensing uncertainty and clarify the 50.59 change process. Progress is slower than expected as NRC staff and industry are continually working toward alignment and updating the draft guidance, section by section.

Draft NEI 96-07, Revision 1, Appendix D, Section 2, "Definitions" preliminarily complete.

Draft NEI 96-07, Revision 1, Appendix D, Section 3, "Screen Guidance" is currently underway

#### Potential Regulatory Challenges and Policy Issues

The staff will consult with the Commission if any potential policy issues are identified in implementing this activity.

The staff is working to develop additional flexibilities in guidance to remove licensing consideration of CCF under 10 CFR 50.59 based upon current regulatory framework without the need for rulemaking.

Industry prefers to maintain separation between technical and licensing content from 50.59 discussions. Licensing decisions based upon guidance in current draft Appendix D will necessarily need a technical basis, which is not provided in Appendix D and a separation of this conversation adds to review time and slows progress. Technical guidance in support of draft Appendix D is being developed and reviewed separately as part of NEI's work with MP#1.

Potential actions for modifying the current 10 CFR 50.59 change control process will have to be informed by consideration of backfitting, regulatory analysis, and cumulative effects of regulation.

Staff actions will be impacted if industry does not participate in tabletop exercises.

#### Interactions with Other Action Plan Items

On-going coordination with the CCF working group is necessary to ensure alignment with NRC regulatory guidance and NRC policy for addressing CCF (MP #1).

Implementation of the revised guidance will be addressed as part of the MP #4, including methods of NRC endorsement of the NEI guidance, developing appropriate inspection guidance, consideration of changes to policies and regulations, and consideration of streamlined licensing processes for certain digital I&C upgrades that may not be implemented under 10 CFR 50.59.

### **MP #3. Commercial Grade Dedication of Digital Equipment**

#### Introduction

The staff is currently updating generic agency guidance in support of CGD processes, including specific reference to digital equipment. Staff has also identified activities to: a) engage with stakeholders; b) further evaluate domestic and international standards; and, c) continue to improve NRC regulatory infrastructure and guidance for CGD of digital equipment. The staff will engage with stakeholders to better understand current challenges and evaluate recommended solutions. In addition to the guidance, challenges include taking credit for third party certification (i.e., IEC 61508 SIL certification). Although existing guidance documents provide insights in this area, some have not been fully evaluated by the staff. Once the staff has reviewed this guidance the agency will be able to identify how to best improve the regulatory infrastructure.

#### Background

Many I&C and other digital equipment readily available in the marketplace were not designed specifically for use in nuclear facilities and have not been subject to NRC quality assurance criteria (as defined in Appendix B to 10 CFR Part 50). In order for this equipment to be used in safety-related and important-to-safety digital equipment (those whose adverse performance could challenge the assumptions in safety analyses), they must undergo CGD under 10 CFR Part 21. For the purposes of this discussion, we will refer to this equipment as CGI.

In order for CGI to be properly dedicated, critical characteristics (important design, material, performance, and dependability characteristics) must be defined and verified for the CGI to provide reasonable assurance that the equipment will perform its intended safety function. The verification step is critical and must be performed by a dedicating entity (equipment manufacturer, NRC licensee, or an independent third-party dedicator). Increasing the number of digital CGIs in the marketplace which have been dedicated could help to streamline the procurement process and reduce the licensing burden for nuclear facilities.

Industry guidance has been developed to clarify what steps are needed when evaluating and accepting CGI as dedicated equipment. Work is underway, through the development of Draft Regulatory Guide (DG)-1292 “Dedication of Commercial-Grade Items for Use in Nuclear Power Plants”, to improve NRC guidance in support of CGD processes and reference some of these standards. Specifically, Revision 1 of Electric Power Research Institute (EPRI) NP-5652 and TR-102260, “Guideline for the Acceptance of Commercial-Grade Items in Nuclear Safety-Related Applications,” Section 14.1 on digital equipment and computer programs integral to plant safety systems include references to two technical reports which have been reviewed and endorsed by the NRC:

- EPRI TR-106439 “Guideline on Evaluation and Acceptance of Commercial-Grade Digital Equipment for Nuclear Safety Applications”; and,
- EPRI TR-107330 “Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants”

This plan provides activities intended to evaluate the suitability of additional guidance and standards and determine if the NRC should endorse them for the purpose of defining critical characteristics of CGI and the mechanism by which they are verified.

Digital equipment is sometimes embedded within other components used in nuclear facilities. As noted, this equipment is not specifically designed for nuclear applications. However, there may be advantages to using this commercial-grade digital equipment, such as the large amount of operating experience generated from use in non-nuclear applications.

In addition to dedicated digital devices and I&C components, establishing improved guidelines for CGD will also be applicable to embedded digital devices (EDDs). As equipment is replaced within licensee facilities, new safety-related components may contain EDDs. The staff recently issued RIS 2016-05, "Embedded Digital Devices in Safety-Related Systems," to alert industry for the need to control implementation of these devices. Certain forms of CCF and other new vulnerabilities can result from the introduction of EDDs.

Industry has stated that NRC licensing burden and licensee regulatory risk could be reduced by leveraging certification of commercially available digital hardware and software by independent third parties with demonstrated expertise and experience for part or all of a CGD process. This independent, third-party "certification" has been effective in some other industries. These certifications, including certification to International Electrotechnical Commission 61508, "Functional Safety", are used to demonstrate a high quality development process was used to develop digital hardware and software equipment. The use of this process, either alone or in conjunction with the CGD process, could reduce the scope of digital systems reviews that the staff needs to complete. The staff will need to evaluate this concept and any policy implications that it may have.

### Objectives

The goal of this activity is to identify needed improvements to the regulatory infrastructure. The objective of any regulatory improvements is to ensure that the implementation of digital devices (including EDDs) is being appropriately evaluated by licensees, applicants, and suppliers; and in compliance with regulations and policy.

### Actions

Activity	Schedule
1. Public Meeting to discuss resolution of RIS 2016-05 public comments.	April 06, 2016 (c)
2. Issue RIS 2016-05.	April 29, 2016 (c)
3. Obtain public comments on DG-1292.	July 2016
4. Stakeholder interaction to discuss proposed use of standards and third party process "certifiers".	3 <sup>rd</sup> /4 <sup>th</sup> Qtr CY 2016
5. NEI provide a revision to the "Digital Device Procurement" white paper (appendix C from the April 22, 2016 NEI submittal) to further clarify objectives, terminology and incorporate discussion points from the November 3, 2016 public meeting.	January 2017

6. Assess results of stakeholder information gathering and examine potential approaches for reviewing and endorsing additional EPRI guidance related to CGD.	1 <sup>st</sup> Qtr CY 2017
7. EPRI to confirm and communicate scope and schedule for EPRI research. NRC and industry reach mutual agreement on acceptability and sufficiency for this purpose. EPRI research begins.	1st Qtr CY 2017
8. NRC / Stakeholder regular interaction to discuss progress and course adjustment as necessary.	CY 2017
9. Issue RG-xxxx "Dedication of Commercial-Grade Items for Use in Nuclear Power Plants".	March 2017
10. Investigative and research activities to evaluate third-party process "certification" for digital equipment.	CY 2017
11. EPRI publish research results	1st Qtr 2018
12. Schedule development and production of a final product (RG) for NRC endorsement of 3rd party certification guidance	CY 2018
13. Complete analysis and develop recommendations regarding third-party process "certification" working with stakeholders.	CY 2018

#### Status

(As of December 1, 2016)

Progress has been made as planned on activities 1 through 4 in the actions table above. On November 3, 2016 NRC Staff met with representatives from NEI and industry as part of activity #4. This resulted in an NRC request to NEI/Industry for suggested additions to the action table which were previously provided but also reflected above.

It is anticipated that the plan will continue to evolve positively in early 2017 and beyond. Stakeholder interaction is expected to generate discussion and agreement on necessary details to further clarify the objectives and expand the plan appropriately. In the spirit of an integrated effort, it is likely that activities will continue to be added that reflect both NRC and NEI/industry responsibilities.

#### Potential Regulatory Challenges and Policy Issues

There is potential for change in scope due to resolution of CCF (MP #1) and through review and consideration of stakeholder proposals for alternative approaches for addressing this issue.

Staff evaluation may identify potential policy issues arising from analysis and recommendations related to third-party process "certification." The staff will consult with the Commission if any potential policy issues are identified in implementing this activity.



Potential actions for addressing commercial grade dedication issues will have to be informed by consideration of backfitting, regulatory analysis, and cumulative effects of regulation.

#### Interactions with other Action Plan Items

This activity will take into account the results from activities relating to CCF (MP #1) and 10 CFR 50.59 (MP #2). To provide the broadest possible agency alignment, this plan will also be coordinated with staff supporting fuel-cycle facilities (NMSS), identification of critical digital assets (NSIR), vendor inspections, and identification of counterfeit or fraudulent parts.

This activity will also be coordinated within the context of the assessment activities as part of MP #4 to modernize the regulatory infrastructure.

## **MP #4. Assessment for Modernization of the Instrument & Control Regulatory Infrastructure**

### Introduction

While activities in MP #1-3 above are considered by staff and industry to be important in the near-term, MP #4 focuses on: identifying and implementing the complete set of activities needed to provide tactical regulatory clarity and support industry confidence to perform digital I&C upgrades; and, identifying additional efficiencies and improvements to effectiveness to modernize the regulatory infrastructure in support of the strategic goal. This activity entails a broad look at the current I&C regulatory infrastructure (regulations and guidance), experiences from past licensing, inspection, and operating experience, and stakeholder suggestions and priorities. This activity and the continuing work on the previous three activities will be executed in a coordinated and integrated manner.

### Background

MPs #1-3 of this plan identify specific activities in which significant work will be accomplished in 2016 and 2017. The staff has identified other issues and areas for potential improvement to the regulatory infrastructure, many which may be dependent on outcome of MPs #1-3. Some potential improvement items are broad-scoped in nature and others are focused on more specific regulatory challenges. Therefore, it is prudent to begin work on these activities in 2017 after progress is made on MPs #1-3.

A list of modernization topics is provided in Appendix A. This list is based on stakeholder feedback and experience from staff across multiple NRC Offices. The staff's broad assessment will include evaluation of the list as part of the scope of the action plan. The staff will explore new high-level performance-based requirements or expectations, simplified regulatory infrastructure that allows for future designs and technologies, and the concept of other innovative processes such as third-party assessment or certification.

### Objectives

The objective of this effort is to perform a comprehensive modernization assessment to identify further improvements to the regulatory infrastructure and develop plans for accomplishing such improvements. The staff recognizes that some additional modernization topics will be strategic in nature, while others can also support more tactical digital I&C plans by industry. The staff will update and consider the list of topics in Appendix A to determine the appropriate sequence of activities. There are two key objectives with the assessment:

(A) Tactical. Prioritize and implement the complete set of regulatory activities, including building upon those in the first three MPs, needed to provide tactical regulatory clarity and support industry confidence to perform digital I&C upgrades. These activities will include but may not be limited to: a) implementing an updated CCF position into technical guidance for use both in concert with endorsed 50.59 change authority guidance and additional licensing guidance improvements, b) licensing guidance including evaluating lessons learned from review of license applications, including factory acceptance testing and scope of supporting application material, c) developing inspection guidance for digital I&C upgrades performed under 10 CFR 50.59 and license approvals.

The staff has initially identified these additional topic areas as being necessary to meet objective A and will seek stakeholder feedback in identifying the complete list of activities from its review of all activities listed in Appendix A. The staff will develop detailed schedules for additional, high-priority tactical topics during the comprehensive modernization assessment.

Completion of these regulatory activities should result in common understanding with stakeholders that there is appropriate regulatory clarity and predictability, and industry confidence in performing new digital I&C upgrades under 10 CFR 50.59 change authority and licensing requests. To support digital upgrades under 10 CFR 50.59, the staff will coordinate with the industry to perform table top exercises with the staff on proposed upgrades to verify the new guidance is clear and consistent, and results in predictable conclusions. The staff will work with industry to conduct a demonstration of the proposed modification to CCF regulatory position prior to developing implementation guidance. Once insights are gained from the demonstration of the proposed CCF changes, the staff will implement revised guidance to improve the efficiency of the license application review process and will work with stakeholders to identify efficiency metrics for application reviews.

(B) Strategic. Broadly evaluate the current overall I&C regulatory infrastructure and consider other important areas beyond those identified in the tactical activities, such as past review experiences, ongoing licensing review and research efforts, lessons learned from operating experience, insights from other safety-critical industries, and international perspectives to identify and prioritize the improvements to modernize the regulatory infrastructure over the longer term in light of evolving approaches to I&C. Success within this objective will be reflected by a simpler, streamlined, and agile I&C regulatory infrastructure that will effectively address large scale digital I&C facility upgrades and I&C designs for new and advanced reactors, as well as medical radioisotope production and irradiation facilities. In developing these longer-term improvement approaches, the staff's efforts will be coordinated with the industry and other stakeholders, including utilities, vendors, manufacturers, standards development organizations, and members of the public that are expected to have a role in achieving the intended success of this modernization effort. The staff will use the principles and attributes directed by the Commission and will consider those identified by the industry as success measures. The principles and attributes include (but are not limited to): safe, secure, performance-based, technology-neutral, efficient, effective, consistent, predictable, durable, simple, unambiguous, timely, scalable, and agile. The outcome will also improve the clarity on the interrelationships between the regulatory issues, the priorities and sequencing of further improvements, and the supporting research that is needed to accomplish such improvements to meet both objectives. The staff will conduct research activities as part of the development of technical bases for these activities as needed to support strategic modernization efforts. Completion of these modernization efforts will result in greater regulatory efficiency and agility in addressing strategic digital I&C applications by the nuclear industry.

### Actions

Develop and evaluate options and sequence of activities for improving the I&C regulatory infrastructure, in concert with activities performed in MPs #1 -3. The following activities will be performed.

<b>Activity</b>	<b>Schedule</b>
1. Update candidate list of modernization topics in Appendix A and begin assessment.	January 2017
2. Identify, prioritize, and begin evaluation and implementation of additional regulatory improvements needed beyond those needed in MPs #1-3 to meet Objective 4A (i.e., tactical objectives).	March 2017
3. Conduct a series of public stakeholder meetings (e.g., public workshops) for additional feedback.	January - April 2017
4. Coordinate with stakeholders to identify potential regulatory gaps and potential options for improving the regulatory infrastructure for Objective 4B.	May 2017
5. Develop additional detailed modernization plans for implementing tactical and strategic improvements to the regulatory infrastructure.	TBD

#### Status

(As of December 1, 2016)

A working group will be established in late 2016 and the modernization assessment will begin in January 2017.

#### Potential Regulatory Challenges and Policy Issues

The staff will consult with the Commission if any potential policy issues are identified in implementing the modernization assessment in this activity.

Resource requirements will be periodically assessed and those actions that provide the most significant improvements will be addressed using the current Planning Budgeting and Performance Management process.

The broad scope of the assessment and its resultant approaches may require additional resources to achieve the goal of modernizing the I&C regulatory infrastructure. In addition, modernization will have to be informed by consideration of backfitting, regulatory analysis, and cumulative effects of regulation.

A key regulatory challenge is understanding the relationships and key dependencies between current efforts to update the regulatory infrastructure (MPs #1-3) and the various items for potential improvement.

#### Interactions with other Action Plan Items

The progress and results of MPs #1-3 will be integrated in this plan.

## **Appendix A**

### **Additional Regulatory Infrastructure Modernization Topics (March 2017)**

The following are additional topics for future modernization efforts in 2017, after work has progressed on MPs #1-3 of the action plan.

#### **(i) Improved Licensing Review Guidance for Digital I&C Systems**

Industry stakeholders believe that the level of technical detail submitted in license applications, license amendments, and licensing topical reports, as well as the timing and sequence of the technical information expected to be submitted for NRC evaluation during the review cycle should be reassessed and improved. Key issues that will be considered in future modernization activities for licensing review guidance include (but are not limited to) the concept of evaluating and approving new digital I&C prior to the factory acceptance test, and the timing and sequence of providing supporting documentation during the licensing review period. The NRC will also consider developing guidance on voluntary, applicant-proposed cybersecurity evaluations in design reviews.

#### **(ii) Improvement in Regulatory Consistency from Licensing to Inspection**

Industry stakeholders believe that upfront agreement and communication on generic digital I&C technical matters between licensing staff and the regional office inspection staff is required to increase predictability. Key issues that will be considered in future modernization activities may include improved mechanisms for sharing information and feedback from licensing to inspection activities, and inspection experience back to future licensing activities.

#### **(iii) Incorporation by Reference (IBR) of IEEE Standard 603-2018 into 10 CFR 50.55(a).**

In SECY-15-0106, the staff proposed to the Commission to incorporate by reference IEEE Std. 603-2009 with certain licensing and technical conditions into 10 CFR 50.55a. The Commission did not approve publishing the proposed rule. Key issues that will be considered in future modernization activities will include NRC participation in the consensus standard development process for IEEE Std. 603 and potential incorporation of a subsequent IEEE Std. 603 standard into regulation.

#### **(iv) Approval of Endorsement of IEEE Standard 7-4.3.2 into a Regulatory Guide**

In SECY-15-0106, the NRC staff proposed to the Commission to IBR IEEE Std. 603-2009 with certain conditions into 10 CFR 50.55a. Although not approved by the Commission, some of the proposed, digital-specific conditions in SECY-15-0106 are more closely aligned with the scope and purpose of IEEE Std. 7-4.3.2. Key activities to be considered in future modernization efforts may include; engaging the consensus standard development organization to evaluate technical guidance in IEEE Std. 7-4.3.2; NRC participation in the consensus standard development process for IEEE Std. 7-4.3.2, and potential approval or endorsement of the standard in a RG.

(v) EDDs

NRC issued RIS 2016-05 to heighten awareness of current regulatory requirements and technical positions for EDDs. The staff intends to further assess the introduction of EDDs into nuclear facility equipment used by licensees and applicants for systems considered important to safety. Key issues that will be considered in future modernization activities may include evaluation of the degree to which licensees are installing EDDs in their facilities and additional regulatory issues related to MPs #1-3.

(vi) Holistic Review of the Regulatory Infrastructure

A holistic regulatory view and approach could be developed that is guided by required fundamental safety principles that would be performance-based, technology neutral, and risk-informed. It would include evaluation of international practices (e.g., standards, guidance, safety cases), evaluation of critical digital I&C application approaches in other non-nuclear industries, applicability of a design specific review standard-like approach (e.g., such as proposed for SMRs), advanced reactors activities, and methods of performing hazard analysis.

(vii) Improved Guidance for Evaluation of Highly-Integrated Digital Technologies

Proposed new reactor I&C designs with advanced and highly integrated digital technologies are more challenging for staff to evaluate under current review standards. In general, the current assessment approach does not credit the safety benefits offered by new design approaches and technology, nor does it adequately identify methods to apply for evaluating whether the hazards have been minimized. Key issues that will be considered in future modernization activities will be to improve regulatory guidance for licensees that may addresses topics such as effective hazards analysis and fundamental safety design principals of independence, defense-in-depth, redundancy, and deterministic performance.

(viii) Consistency and Integration of Multiple Regulatory Guidance Documents

Industry stakeholders believe that a full assessment of the SRP content and organization related to digital I&C, and the multiple associated digital I&C-related regulatory guidance documents needs to be performed because the current approach is overly complex and difficult for industry to navigate. Key issues that will be considered in future modernization activities for regulatory guidance include possible methods for consolidating and organizing new and operating reactor RGs, Branch Technical Positions, interim staff guidance, and standard review plans.

(ix) Improved Guidance for Evaluation of Proposed Alternatives to Regulatory Guides and Standards

NRC staff may benefit from improved guidance to address evaluation of licensee-submitted proposed alternatives to the criteria in regulatory guidance and endorsed codes and standards, applicable to the licensing of digital I&C systems and components. Key issues that will be considered in this modernization activity include identifying gaps in current guidance that create a consistency challenge for technical reviewers of proposed alternative solutions.

(x) Improved Process for Digital I&C Topical Report Evaluations

The expenditure of NRC staff resources for the review of digital I&C platform topical reports has not gained the efficiencies in performing licensing evaluations as was originally envisioned. A process is needed to effectively and efficiently address updates to topical reports. Industry wishes the NRC to recognize that a vendor can use a screening and evaluation procedure to document the assessment to changes in a platform to maintain its original topical report qualification. Key issues that may be considered in this modernization activity include engaging vendor and licensee stakeholders to identify topical report challenges and establish a process for maintaining topics for frequent reference in future license applications.