

December 16, 2011

MEMORADUM FOR: R. W. Borchardt
Executive Director for Operations
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FROM: John A. Grobe, Chairman **/RA/**
Digital Instrumentation and Control Steering Committee
Office of Nuclear Reactor Regulation

SUBJECT: DIGITAL INSTRUMENTATION AND CONTROL (DI&C)
STEERING COMMITTEE'S EFFORTS TO IMPROVE THE
PREDICTABILITY AND EFFECTIVENESS OF DI&C REVIEWS

This Memorandum describes the activities accomplished by the Digital Instrumentation and Control (DI&C) Steering Committee and basis for retiring the Steering Committee.

In January 2007, in response to a November 8, 2006, Commission meeting and the Staff Requirements Memorandum (SRM) dated December 6, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML0634000331), the U.S. Nuclear Regulatory Commission (NRC) staff initiated a project to improve the regulatory efficiency and predictability of licensing DI&C systems in new and existing power reactors. During the November 8, 2006, Commission meeting, the industry panel, which included the Nuclear Energy Institute (NEI), expressed concerns about the ability to license digital I&C safety systems and implement certain NRC policies regarding DI&C. NEI stated that NRC guidance needed additional improvements to facilitate the nuclear industry's needed retrofits of aging analog systems in operating reactors and orders for new reactor simulators. In response to the SRM, the staff established the DI&C Steering Committee (ADAMS Accession No. ML063390606) comprised of key NRC executives responsible for assuring the safety and security of operating reactors, new reactors, and fuel cycle facilities and implementing the NRC's regulatory research program. The Steering Committee was created to provide management focus across NRC organizational boundaries to develop a more predictable, consistent and efficient regulatory process, to interface with the industry, and to facilitate resolution of strategic and regulatory challenges. The industry established a parallel group of industry executives to coordinate industry efforts and interface with NRC staff.

The Digital I&C Steering Committee has for the past five years successfully supported the completion of the DI&C project plan, advised line organizations, ensured completion of the actions directed in the above discussed SRM, and provided an effective interface with all external stakeholders on these issues. At the final Commission briefing on this subject on February 1, 2011, the staff informed the Commission that all of the tasks associated with the SRM had been or would shortly be completed and the DI&C Steering Committee would be completing its work and transitioning to a new method for interfacing with external stakeholders.

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On December 6, 2011, NRC management and staff from the Offices of Nuclear Reactor Regulation and New Reactors met with representatives of the nuclear industry in a public meeting to discuss ongoing issues in this area. At the meeting it was agreed that communication with NRC line organization management could successfully support continued dialog on issues of mutual interest and would continue on a semiannual basis.

As part of its work over the past five years the DI&C Steering Committee identified high priority issues, articulated them as problem statements in a DI&C project plan, and directed six task working groups (TWGs) to resolve them. Subsequently, the staff formed a seventh TWG to resolve similar issues for fuel cycle facilities. The Steering Committee determined that Interim Staff Guidance documents (ISGs) would be issued to address the problem statements and meet the need for additional guidance specified in the DI&C project plan. The DI&C Steering Committee decided the ISGs would subsequently be incorporated into NRC's regulatory infrastructure in the form of regulations, revisions to the Standard Review Plan (SRP), Branch Technical Positions (BTPs), regulatory guidance, regulatory reports, or industry consensus standards, as appropriate. The ISGs described one acceptable approach for addressing each specific technical area to attempt to increase regulatory predictability and reduce the burden of the NRC review. The TWGs considered industry and public comments on draft versions of the ISGs in public meetings before issuing the final documents. The NRC staff started revising the regulatory infrastructure upon completion of the ISGs and follows well-defined and understood formal public processes to make the revisions. The NRC staff use the ISGs in ongoing reviews of facility and vendor applications for use of digital technology and have improved the predictability and consistency of the reviews. The NRC staff and industry provided positive feedback on the use of the ISGs and their effectiveness. The NRC staff will continue to refine the guidance based on experience as they incorporate the guidance into formal regulatory documents.

The DI&C Steering Committee and the TWGs prepared ISGs for all of the technical issues identified in the DI&C project plan. The ISG documents were developed with significant input from external stakeholders through a series of more than 100 public meetings and public comments received on draft versions posted on the NRC public website. The TWGs addressed the technical issues of cyber security (TWG-1), diversity and defense-in-depth (TWG-2), review of new reactor DI&C probabilistic risk assessments (PRA) (TWG-3), highly-integrated control room communications (TWG-4), highly-integrated control room human factors (TWG-5), the licensing process (TWG-6), and fuel cycle facilities (TWG-7). TWG-6 provided additional guidance on the scope and conduct of the review of digital retrofits to operating plant safety systems. TWG-7 addressed many of the same technical and licensing questions as the other TWGs, but with special consideration of the significant differences in licensing requirements for fuel cycle facilities and consequences of digital system failures.

TWG-1 provided clarification on acceptable methods to meet NRC requirements for cyber security. NRC Regulatory Guide (RG) 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," Revision 2, and draft NEI 04-04, Revision 2 (ADAMS Accession No. ML073461212), describe an acceptable cyber security program for protecting safety-related digital systems from internal and external cyber attacks. TWG-1 issued DI&C-ISG-01 (ADAMS Accession No. ML072980159) in December 2007, clarifying one acceptable method for meeting NRC cyber security requirements, including draft NEI 04-04, Revision 2, and a cross correlation table (ADAMS Accession No. ML072980164) between the guidance in RG 1.152, Revision 2,

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and draft NEI 04-04, Revision 2. Subsequent to the issuance of ISG-DI&C-01 the staff issued Section 73.54, "Protection of Digital Computer and Communications Systems and Networks," of Title 10 of the *Code of Federal Regulations* (10 CFR) and RG 5.71, "Cyber Security Programs for Nuclear Facilities." This guidance, based in part on the work of TWG-1 defined the process for the review of cyber security in nuclear facilities. To bring regulatory reviews of digital systems for new reactors or upgrades to existing reactors in line with the requirements of 10 CFR 73.54, RG 1.152, Revision 3, was issued in July 2011, and reflects the updated approach. All short term and long term actions associated with TWG-1 are complete.

TWG-2 provided clarification of staff guidance in BTP 7-19 regarding diversity and defense-in-depth. In 2007, TWG-2 developed DI&C-ISG-02 (ADAMS Accession No. ML072540118) which addressed system characteristics that comprise adequate diversity and sufficient defense-in-depth, criteria for crediting the use of operator manual actions as a defensive measure, system level or component level actuation of equipment when manual actuation is used as a defensive measure, the effects and applicability of common cause failures, echelons of defense, and whether common cause failures are classified as single failures in design basis evaluations. The ISG provided several alternatives for designers to meet the diversity and defense-in-depth guidance. The NRC staff reviewed domestic and international operating experiences to ensure that the guidance would provide an adequate level of safety. DI&C-ISG-02 was updated in 2009 (ADAMS Accession No. ML091590268) and is currently being integrated into a revision of BTP 7-19, as part of becoming part of the formal regulatory infrastructure. The revised BTP has been through the public comment process and reviewed by the Advisory Committee on Reactor Safeguards. The staff anticipates issuing the revised BTP in March 2012.

Pursuant to 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," new nuclear power reactors are required to include a description of the design specific PRA and its results in the Design Certification or Combined Operating License application. TWG-3 developed DI&C-ISG-03 (ADAMS Accession No. ML080570048) describing the characteristics of a PRA for safety-related digital I&C systems, which NRC staff will evaluate during review of applications. DI&C-ISG-03 will be integrated into Chapter 19 of the SRP during its next revision, currently planned for fiscal year (FY) 2013.

TWG-4 identified that NRC guidance for highly integrated digital control rooms needed refinement on adequate communications independence. Specifically, the guidance needed to better address communications independence between individual digital systems, between safety divisions within a digital system, between a digital system and non-safety I&C system, and between a safety division within a digital system and a non-safety I&C system. Additional areas for improving the guidance included command prioritization between safety and non-safety commands, design of multidivisional control and display stations, and digital system network configuration to assure safety. In 2007, TWG-4 developed DI&C-ISG-04 (ADAMS Accession No. ML072540138) that provided one acceptable method to address these communication issues. The NRC staff updated DI&C-ISG-04 in 2008 (ADAMS Accession No. ML082740440) to provide additional guidance on human factors issues. The guidance in DI&C-ISG-04 will be incorporated in the next revision of Institute of Electrical and Electronics Engineers Standard 7-4.3.2, "Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations," and referenced in revision 4 to RG 1.152, anticipated to be completed in FY 2013.

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TWG-5 addressed human factors issues with highly integrated digital control rooms. The human-systems interface (HSI) concerns include the minimum inventory of alarms, controls, and displays needed to implement emergency operating procedures, use of computerized procedures and soft controls, implementation of the Safety Parameter Display System pursuant to 10 CFR 50.34(f)(iv), a graded approach to human factors issues, and criteria for evaluating operator manual actions as a defensive measure in lieu of diverse automatic actuation systems. In 2007, TWG-5 developed DI&C-ISG-05 (ADAMS Accession No. ML072540140) which provided enhanced guidance on one acceptable method to address HSI issues. TWG-5 issued DI&C-ISG-05, Revision 1 (ADAMS Accession No. ML082740440) in 2008, and plans to integrate the ISG into Chapter 19 of the SRP during its next revision, currently planned for FY 2013.

TWG-6 developed DI&C-ISG-06 (ADAMS Accession No. ML110140103) that provides the level of detail needed in a licensing application and describes the process for NRC review of digital modifications to safety systems in operating plants. The guidance identifies the documentation needs and methods, and reduces regulatory uncertainty in the review process and improves efficiency in preparing the application. In developing DI&C-ISG-06, the NRC staff incorporated the lessons learned from the reviews of the DI&C reactor protection system and/or engineered safety features actuation systems (RPS/ESFAS) retrofit applications for the Oconee and Wolf Creek facilities. The DI&C-ISG-06 was completed in January 2011, and is currently being piloted as part of the Diablo Canyon RPS/ESAFS retrofit application review. The guidance provided in DI&C-ISG-06 will be integrated into Chapter 7 of the SRP when the Diablo Canyon pilot is complete.

TWG-7 addressed many of the same technical and licensing questions as the other TWGs, but with special consideration of the significant differences in licensing requirements for fuel cycle facilities and consequences of digital system failures. TWG-7 issued DI&C-ISG-07 in 2009 (ADAMS Accession No. ML091550599), and revised it in December 2010 (ADAMS Accession No. ML101900316). DI&C-ISG-07 will be incorporated into a future revision of NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility."

In addition to the work of the TWGs, the NRC staff has continued to improve regulatory guidance and the NRC staff review process through actively working with international regulatory counterparts and key stakeholders to address high-priority issues in a timely manner. One example is digital aspects of the Multinational Design Evaluation Program (MDEP), an initiative to develop innovative approaches and leverage the resources and knowledge of other regulatory authorities with experience in these areas. The NRC staff participated in the MDEP new reactor design-specific working groups and chairs the MDEP DI&C working group. As DI&C technology evolves and new information becomes available, the NRC staff will continue to update regulatory guidance in this area. The NRC staff will continue to work with all stakeholders, including the industry, to guide ongoing research to help inform and resolve technical issues and support regulatory infrastructure improvements.

Throughout this process the DI&C Steering Committee has worked closely with the industry and public and has refined its regulatory guidance by addressing a number of technical issues associated with safety-related applications of DI&C technology. This has resulted in a more predictable and efficient regulatory review of applications for DI&C system modifications at operating reactors and new reactor Design Certifications and Combined Operating License

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applications. The staff will continue to work collaboratively with the industry and public to resolve further issues associated with the application of digital technology at operating and new nuclear power plants and meet periodically with industry to ensure effective communications.

With the completion of these tasks and the transfer of the role of providing a regular interface with external stakeholders to line NRC management, the DI&C Steering Committee will formally disband effective December 16, 2011.

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