



**UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001**

April 21, 2009

The Honorable Dale E. Klein
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: DIGITAL I&C INTERIM STAFF GUIDANCES 5, "HIGHLY-INTEGRATED CONTROL ROOM-HUMAN FACTORS ISSUES," AND 6, "LICENSING PROCESS"

Dear Chairman Klein:

During the 561st meeting of the Advisory Committee on Reactor Safeguards, April 2 - 4, 2009, we reviewed the Draft Final Revision 1 to the Digital Instrumentation & Controls (DI&C) Interim Staff Guidance, (ISG)-5, "Highly-Integrated Control Room - Human Factors Issues," and Draft ISG-6, "Licensing Process." Our Digital Instrumentation & Control Systems Subcommittee also reviewed this matter during a meeting on February 26 - 27, 2009. During these reviews, we had the benefit of discussions with representatives of the NRC staff. We also had the benefit of the documents referenced.

RECOMMENDATIONS

1. Section 3, "Crediting Manual Operator Actions in Diversity and Defense-in-Depth (D3) Analyses," of ISG-5 should be revised to incorporate additional guidance on the estimation methods of the time required for operator action. Increased rigor in the supporting analyses should be required as the difference between the time available and the time required for operator action decreases.
2. Draft ISG-6 should not be issued until Sections C and D are revised to specify that sufficient design detail be provided to ensure deterministic behavior and independence of each DI&C safety train.

BACKGROUND

In ISG-5 and ISG-6, the staff uses the terms "time available" and "time required" for operator actions. The "time available" is based on engineering calculations and is the time within which action must be taken to mitigate adverse conditions. The "time required" is based on human factors engineering analyses and is the time the operators will need to take appropriate action. DI&C-ISG-2, "Diversity and Defense-in-Depth Issues," was issued in September 2007 to provide guidance on meeting the D3 requirements. It identifies the installation of an independent and diverse automated backup system as an acceptable approach. It also identifies manual actions as an alternative D3 approach for situations in which the time required is less than the time available, as long as the time available is greater than thirty minutes. In our October 16, 2007, report, we recommended that an alternative process to the thirty-minute criterion be developed

to determine the conditions under which operator actions can be credited as a diverse protection function. A new Section 3 of ISG-5 was developed to provide such guidance.

ISG-6, "Licensing Process," provides guidance for the NRC staff's review of DI&C systems in accordance with current licensing processes. This ISG also describes the information and documentation the NRC staff will need for its review of license amendment requests (LARs) for DI&C upgrades in operating plants and when the information should be provided. We reviewed a previous version of this Draft ISG during our 551st meeting on April 10-12, 2008. Subsequently, it was revised to incorporate the lessons learned from the Oconee and Wolf Creek DI&C system upgrades.

DISCUSSION

ISG-5, Section 3: Crediting Manual Operator Actions in Diversity and Defense-in-Depth Analyses

Section 3 of ISG-5 was developed to provide an alternative process to the thirty-minute criterion to determine the conditions under which operator actions can be credited.

The staff's proposed approach for evaluating operator action credit consists of four phases: Analysis, Preliminary Validation, Integrated System Validation, and Maintaining Long Term Integrity of Credited Manual Actions in the D3 Analyses. Each of the phases includes acceptable methods and review criteria.

Phase 1, Analysis, includes a list of methods acceptable to the NRC staff for deriving estimates of the time required for task components. These include operator interviews and surveys, operational experience, mockups, task analysis, simulator experiments and measurements of operator responses in simulated evolutions, and expert judgment elicitation. The time estimates derived using these methods can be biased and the associated uncertainties can be difficult to assess. These issues have been studied, and structured approaches have been proposed to minimize the biases and help with uncertainty assessment. Such an approach is proposed in the Senior Seismic Hazard Analysis Committee (SSHAC) Report, NUREG/CR-6372. The references provided in the ISG contain much useful information. The ISG should provide specific links to this information.

As the difference between the time available and time required decreases, confidence in the analysis also decreases. The discussion under Staff Position should be revised to clearly state that the degree of validation for acceptance of credit should be more stringent for this situation. ISG-5 addresses a difficult problem. We commend the staff for developing a thoughtful and coherent approach.

ISG-6: Licensing Process

ISG-6 clarifies the scope of information that is required for the NRC staff review of DI&C upgrades at operating plants. Section C of ISG-6 divides the licensing review process into four phases, Phase 0 - Pre-Application Meetings, Phase 1 - Initial Application, Phase 2 - Continued Review and Audit, and Phase 3 - Implementation and Inspection. Within this structure, the ISG lays out 3 Tiers, each corresponding to an expected level of complexity and correspondingly higher level of review. Tier 1 would apply for LARs using a previously approved system with no deviations. Tier 2 would apply for LARs using a previously approved system with deviations to

suit the plant-specific situation. Tier 3 would apply for LARs using a totally new system with no generic approval.

In Section C Phase 0, the primary focus is on the applicant's approach to Diversity and Defense-in-Depth, software, and planned deviations from current staff positions. The use of DI&C systems introduces additional complexity into how independence between reactor protection system trains and engineered safety features actuation system trains is achieved. DI&C systems also introduce additional complexity in ensuring a deterministic signal path from plant parameter data acquisition, through analog and digital processing, to safety control device actuation. The critical issues of independence and determinism should be emphasized in this Section.

In Section C, Phase 1, the guidance specifies that the LAR should include information sufficient to address a list of technical subject areas. Section D, Review Areas, still under development, provides the framework of review details for each of the areas listed in Section C, Phase 1. The staff should ensure that the Phase 1 list and the associated list in Section D are revised to explicitly include division independence and determinism. Also, the staff should ensure that Sections C and D emphasize that the information provided for all areas contain sufficient detail, including diagrams, to clearly illustrate how the design will meet DI&C design criteria. The information requested should include detailed information on independence, safety train to safety train communication and data isolation, and analysis that clearly confirms determinant and uninterrupted signal path processing.

We look forward to future presentations and discussions as the staff continues to refine these ISGs.

Sincerely,

/RA/

Mario V. Bonaca
Chairman

References:

- (1) U.S. Nuclear Regulatory Commission, Digital Instrumentation & Control (DI&C)-ISG-5 Rev 1, "Highly-Integrated Control Room-Human Factors Issues," dated November 3, 2008, Rev.1 (ML082740440)
- (2) U.S. Nuclear Regulatory Commission, Digital Instrumentation & Control (DI&C)-Draft ISG-6, "Licensing Process," dated January 14, 2009 (ML090130273)
- (3) U.S. Nuclear Regulatory Commission, Digital Instrumentation & Control (DI&C)-ISG-2, "Diversity and Defense-in-Depth Issues," dated September 26, 2007 (ML072540118)
- (4) NUREG-0800 Chapter 7 Branch Technical Position 7-19, "Guidance for Evaluation of Diversity and Defense-in-Depth in Digital Computer-Based Instrumentation and Control Systems," Rev. 5, dated March 2007 (ML070550072)

- (5) U.S. Nuclear Regulatory Commission, Senior Seismic Hazard Analysis Committee (SSHAC), NUREG/CR-6372, "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts," Volumes 1 and 2, dated April 1997 (ML080090003 and ML080090004)
- (6) Report from William J. Shack, Chairman, Advisory Committee on Reactor Safeguards, to Dale E. Klein, Chairman, NRC, "Digital Instrumentation & Control System Project Plan, and Interim Staff Guidance," dated October 16, 2007 (ML072810006)

- (5) U.S. Nuclear Regulatory Commission, Senior Seismic Hazard Analysis Committee (SSHAC), NUREG/CR-6372, "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts," Volumes 1 and 2, dated April 1997 (ML080090003 and ML080090004)
- (6) Report from William J. Shack, Chairman, Advisory Committee on Reactor Safeguards, to Dale E. Klein, Chairman, NRC, "Digital Instrumentation & Control System Project Plan, and Interim Staff Guidance," dated October 16, 2007 (ML072810006)

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