



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
WASHINGTON, D. C. 20555

ACRSR-1707

PDR

June 23, 1997

Mr. L. Joseph Callan  
Executive Director for Operations  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555-0001

Dear Mr. Callan:

SUBJECT: REGULATORY GUIDANCE FOR IMPLEMENTATION OF DIGITAL  
INSTRUMENTATION AND CONTROL SYSTEMS

During the 442nd meeting of the Advisory Committee on Reactor Safeguards, June 11-14, 1997, we reviewed the proposed final update of Standard Review Plan (SRP), Chapter 7, "Instrumentation and Controls," including Branch Technical Positions (BTPs) and associated Regulatory Guides related to digital instrumentation and control (I&C) systems. We also discussed the staff's integration of insights from the National Research Council Phase 2 Study Final Report and a draft safety evaluation report on an Electric Power Research Institute (EPRI) Topical Report, TR-106439, "Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications." During this review, we had the benefit of discussions with representatives of the NRC staff and its contractor, the Lawrence Livermore National Laboratory (LLNL).

We previously met with the National Research Council panel to discuss its Phase 2 study Final Report during our 439th meeting, March 6-8, 1997. We also had the benefit of the documents referenced.

Conclusions and Recommendations

- We are satisfied that the guidance provided in the update to SRP Chapter 7 is adequate to ensure safety and therefore recommend issuance of the proposed final SRP update and associated guidance.
- We recommend approval of the draft safety evaluation report on the EPRI Topical Report, TR-106439.
- The staff should develop criteria for a graded approach to the review process of digital I&C systems based on safety significance.

9707080061 970630  
PDR ACRS  
R-1707 PDR

070046



08M-7 acks  
X 08M-6 meet

10  
R501

- The staff should participate in workshops to discuss the application of the SRP Chapter 7 update and the use of associated regulatory guidance. The staff may also find it useful to solicit industry participation for a pilot application for I&C systems using the SRP Chapter 7 update.
- The staff should work with the industry to clarify the "system level" issue in Generic Letter 95-02, "Use of NUMARC/EPRI Report TR-102348, 'Guideline on Licensing Digital Upgrades,' in Determining the Acceptability of Performing Analog-to-Digital Replacements under 10 CFR 50.59."
- For systems that contain digital components, the effects of software failures should be included in the probabilistic risk assessment (PRA).

### Discussion

We previously raised issues regarding the graded approach based on importance to safety, the level of detail provided in the Regulatory Guides, the balance in the guidance between the review of the design process and the assessment of the product, as well as the linkage between Chapter 7 and other SRP chapters.

The staff has proposed to adopt the criteria in draft Regulatory Guide DG-1064 for graded quality assurance (GQA) to determine the level of review required for digital I&C systems. We previously expressed concerns with the proposed version of DG-1064 in our report to Chairman Jackson dated March 17, 1997. We do, however, support consideration of an appropriate graded approach for the review of digital I&C systems.

Case studies presented by the staff provide evidence that a well-managed review based on the proposed regulatory guidance can assure that there is balance between the review of the design process and the review of the product. Additional research is necessary to address the specific needs for digital I&C systems and to develop more efficient, improved quantitative means of assessing software quality and performance. The research proposed by the staff is a reasonable first step.

The National Research Council Phase 2 Study Final Report included a recommendation that the staff reexamine its position on the "systems level" issue. The staff has concluded that no further action is required. We believe that the staff should work with industry to reconcile the NUMARC/EPRI guidelines and consider revising Generic Letter 95-02. The lack of clarity on this issue inhibits implementation of digital system technology in nuclear power plants.

For some time, we have raised questions about the treatment of software and digital system reliability in PRAs. The National Research Council report addresses this issue and recommends that the staff develop methods for estimating failure probabilities of software-based digital systems, including systems that use commercial, off-the-shelf software and hardware. We support the research on these topics initiated by the staff.

In summary, there will be a continuing need to maintain and update SRP Chapter 7 and associated guidance as the technology changes and becomes more widely used. Similarly, there is a need for continued effort to clarify guidance for the industry through public workshops and pilot programs.

Sincerely,



R. L. Seale  
Chairman

References:

1. Memorandum dated May 7, 1997, from B. Boger, Office of Nuclear Reactor Regulation (NRR), to J. Larkins, ACRS, Subject: Proposed Final Updated SRP Chapter 7 on Instrumentation and Controls and Final Regulatory Guides on Digital Computer Software Quality, and attached SRP sections, Branch Technical Positions, and Regulatory Guides.
2. Draft Safety Evaluation Report dated May 5, 1997, from D. Matthews, NRR, to R. Torok, EPRI, Subject: Review of EPRI Topical Report TR-106439, Guideline on Evaluation and Acceptance of Commercial Grade Equipment for Nuclear Safety Applications.
3. Electric Power Research Institute, Topical Report, EPRI TR-106439, "Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications," Final Report, October 1996.
4. Generic Letter 95-02, "Use of NUMARC/EPRI Report TR-102348, 'Guideline on Licensing Digital Upgrades,' in Determining the Acceptability of Performing Analog-to-Digital Replacements under 10 CFR 50.59."
5. Committee on Application of Digital Instrumentation and Control Systems to Nuclear Power Plant Operations and Safety, Board on Energy and Environmental Systems, Commission on Engineering and Technical Systems, National Research Council, "Digital Instrumentation and Control Systems in Nuclear Power Plants," Safety and Reliability Issues - Final Report, 1997.
6. NUMARC/EPRI Topical Report TR-102348, "Guideline on Licensing Digital Upgrades," December 1993.

7. Letter dated October 23, 1996, from T. S. Kress, ACRS Chairman, to J. Taylor, Executive Director for Operations, NRC, Subject: Draft Update of Standard Review Plan, Chapter 7, Instrumentation and Controls.
8. Letter dated June 6, 1996, from T. S. Kress, ACRS Chairman, to J. Taylor, Executive Director for Operations, NRC, Subject: Regulatory Guidance Documents Related to Digital Instrumentation and Control Systems.
9. Report dated October 13, 1995, to Shirley A. Jackson, NRC Chairman, from T. S. Kress, ACRS Chairman, Subject: National Academy of Sciences/National Research Council Study on Digital Instrumentation and Control Systems in Nuclear Power Plants, Safety and Reliability Issues - Phase 1.