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CERTIFIED BY:

Don W. Miller - 6/25/96

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
INSTRUMENTATION AND CONTROL SYSTEMS AND COMPUTERS SUBCOMMITTEE
MEETING MINUTES
MARCH 6, 1996
ROCKVILLE, MARYLAND

INTRODUCTION

The ACRS Subcommittee on Instrumentation and Control Systems and Computers met on March 6, 1996, at 11545 Rockville Pike, Rockville, MD, in Room T-2B3. The purpose of this meeting was to review proposed updates to Standard Review Plan (SRP) Sections, and Branch Technical Positions (BTPs), and Regulatory Guides related to instrumentation and control (I&C) systems. The primary purpose of this SRP update is to codify current regulatory guidance related to digital I&C systems. The entire meeting was open to the public. Mr. Michael T. Markley was the cognizant ACRS staff engineer for this meeting. The meeting was convened at 8:30 a.m. and adjourned at 4:30 p.m.

ATTENDEES

ACRS

D. Miller, Chairman
G. Apostolakis, Member
J. Carroll, Member
M. Fontana, Member
T. Kress, Member

R. Seale, Member
W. Shack, Member
C. Wylie, Member
E. Quinn, Invited Expert
M. Markley, ACRS Staff

Principal NRC Speakers

B. Boger, NRR
B. Brill, RES
M. Chiramal, NRR
F. Coffman, RES
J. Kramer, RES

G. Johnson, LLNL*
D. Lawrence, LLNL*
J. Scott, LLNL*
J. Stewart, NRR

* Lawrence Livermore National Laboratory (LLNL) is the contractor conducting work for the NRC staff in this area.

Industry/Public

D. Barboza, DNFSB
J. Scecina, Framatome Tech.
B. Sun, Sunutech, Inc.
W. White, DNFSB
T. Wilson, NAS

DESIGNATED ORIGINAL

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A complete list of meeting attendees is in the ACRS Office File, and will be made available upon request. The presentation slides and handouts used during the meeting are attached to the office copy of these minutes.

Chairman's Opening Remarks

Dr. Don W. Miller, Chairman of the Subcommittee, convened the meeting and summarized the purpose of the meeting to review the staff proposal to update the existing Chapter 7 of the Standard Review Plan (SRP) (NUREG-0800). He introduced Members of the Subcommittee, the ACRS Invited Expert, Edward L. Quinn, and several graduate students from The Ohio State University and the Massachusetts Institute of Technology. Dr. Miller reviewed some points made in a January 3, 1996, memorandum from James M. Taylor, Executive Director for Operations, to Chairman Jackson which stated that 1) the purpose of this update is to "codify" the framework into one package, 2) the update was not required or needed by the industry to facilitate digital upgrades since the regulatory framework already exists, and 3) the update will not introduce any new dimensions into the regulatory framework. He noted that this portion of the SRP will include two SRP Sections (7.0 and 7.1), one Branch Technical Position (BTP-14), and two Regulatory Guides (RGs) which endorse four industry standards. He also stated that this review would include the staff's safety evaluation report (SER) on an Electric Power Research Institute (EPRI) topical report for electromagnetic/radiofrequency interference (EMI/RFI) design requirements and testing.

NRR Presentation

Mr. Matthew Chiramal, Senior Advisor, Instrumentation and Control Branch (HICB), NRR, introduced the NRC staff and led the discussion of proposed update to the SRP (BTPs and SRP Sections). He provided an overview of SRP review process (Section 7.0), a description of the acceptance criteria (design criteria and commitments) for any I&C system (Section 7.1), and the review criteria for evaluating software quality (BTP-14). He discussed the basic requirements, the process for conducting digital system reviews, the NRC model for software life-cycle activities, the integrated schedule of NRC staff and contractor activities, and expected items for future ACRS reviews. He also presented the SER associated with EPRI topical report on EMI/RFI. Important points made during the discussion include:

- The proposed changes to SRP Chapter 7 will maintain existing regulatory bases and will not reduce safety over current practices.

- The proposed SRP update incorporates lessons learned from advanced light water reactor reviews, digital retrofits and industry operating experience. It will include criteria for both operating plants (modifications) and future reactor designs.
- The scope and depth of each review is based on safety significance.
- The staff will integrate insights from the National Academy of Sciences/National Research Council (NAS/NRC) Phase 2 study. The NRC staff plans to issue the SRP Chapter 7 update for public comment in October 1996.

RES/LLNL Presentation

Dr. John A. Scott, LLNL, led the discussion for RES regarding development of RGs and endorsement of industry standards. He noted that the purpose of the regulatory guides is to provide methods acceptable to the NRC in meeting regulatory requirements. He reviewed the approach taken by the NRC staff in endorsing IEEE industrial standards which provide generally accepted U.S. software engineering practices, key aspects of RG development, the relationships and importance of certain standards, conclusions in the regulatory analysis, and exceptions taken by the NRC to positions contained in the standards. Important points made during the discussion were:

- The overall philosophy is to tie the RGs to existing NRC regulations and industry consensus standards.
- IEEE Standards generally define the process and are, therefore, not specific to particular industries.
- The endorsement of software engineering standards has a relatively low resource impact for the NRC staff while providing high value in achieving common understanding of acceptable software practices.
- The selection basis for standard endorsement is the maturity of the standard and its relevance to safety considerations.

Discussion

The Subcommittee and NRC staff discussed the extent to which industry operating experience was incorporated into the SRP update. Mr. Wylie asked specific questions related to plant transients and damage to equipment from inadequate electrical grounding and shielding. Dr. Apostolakis questioned the extent to which they considered non-nuclear industrial experience in

developing guidance. The NRC staff stated that they were integrating industry operating experience into SRP guidance. They also noted that the NRC had contracted NAS/NRC to do an independent comparison with practices used by other industries, in part, as a result of past ACRS actions.

The Subcommittee also discussed how a risk-based approach was integrated into the program. Dr. Miller questioned if Chapter 7 (I&C) and the various other SRP Chapters were linked. The staff stated that each SRP Chapter was being developed separately but that they collectively fit into one overall SRP program (NUREG-0300). The staff did, however, acknowledge that there was limited day-to-day interaction between the staff updating Chapter 7 and those working on the PRA SRP and regulatory guides. ACRS Invited Expert, Mr. Quinn questioned the extent to which a "graded approach" was applied to areas important to safety. Dr. Apostolakis questioned whether there was an overall philosophy of safety neutrality (changes and/or enhancements which neither increase nor decrease risk) and whether quantitative measures were being used. The staff described the approach as being largely a qualitative assessment with regard to evaluating risk and that they were maintaining the traditional defense-in-depth approach to safety.

The Subcommittee and staff extensively discussed the review process. Dr. Miller questioned the extent to which regional inspection personnel were included in the development and reviews. Dr. Apostolakis questioned the staff's emphasis on the review process as opposed to focusing on the quality of products that result from those reviews (process versus product). Dr. Miller noted that many problems result from inadequate requirements and that most are found through testing. There was extensive discussion related to traditional approaches to software development and standards. The staff reiterated their view that their approach was consistent with generally accepted software engineering practices. The staff further stated that they would take exceptions to, and provide additions and clarifications for portions of those standards which differ from NRC positions and regulatory approaches.

The Subcommittee discussed the distinction between SRP Sections and BTPs. The staff pointed out that BTPs provide additional detailed guidance and cover broader aspects of the program which may be entailed in more than one SRP Section. The Subcommittee also questioned the incomplete nature of the references listed at the end of each document. Mr. Quinn identified several important references he believed were not included in the regulatory guides. Mr. Carroll questioned the age of the referenced standards and whether recent lessons learned were incorporated. Mr. Quinn also questioned the number of exceptions the staff had

taken related to the proposed endorsed standards. The NRC staff acknowledged that the reference list could have been more extensive but that they wanted to limit the list to those items which were central to the purpose of each document. The staff also stated that the exceptions were necessary to identify and clarify areas within the standard which the NRC was not endorsing. Mr. Quinn suggested the NRC conduct a workshop to clarify these issues.

The Subcommittee and the staff extensively discussed the issue of complexity as it relates to software for digital I&C and plant safety systems. Mr. Carroll expressed the view that plant safety systems are designed to be simple. He asserted that much of the discussion regarding problems that result from complex software is not productive because the software should be simple.

The Subcommittee discussed the staff's SER on the EPRI topical report for EMI/RFI. Mr. Wylie again questioned the provisions for equipment protection (grounding and shielding) for lightening induced transients. Mr. Quinn questioned whether the NRC had considered testing to validate the topical report. Mr. Carroll noted that EMI/RFI affected analog systems and his belief that will also affect digital systems. He inquired about the status and findings of NRC funded research on environmental stressors at Oak Ridge National Laboratory (ORNL). Individual Subcommittee Members expressed no objection to the proposed endorsement.

Subcommittee Comments and Concerns

At the close of the meeting, Subcommittee Members provided their observations and concerns. Specific issues of concern were:

- The overall SRP Upgrade focuses heavily on software process control as opposed to product validation.
- The coordination with other SRP Chapters is not altogether clear and there may need to be a closer linkage to ensure the integration of risk.
- A graded approach is needed commensurate with safety significance.
- References are incomplete or difficult to trace.
- Clarification is needed for definitions and use of terminology.

Subcommittee Recommendations

The I&C Systems and Computers Subcommittee recommended the NRC staff address the above noted observations and concerns during the full 429th meeting of the Advisory Committee on Reactor Safeguards, March 7-9, 1996. The Subcommittee plans to draft a letter for the full ACRS regarding the regulatory guidance documents for digital I&C systems. The ACRS plans to continue its review of the SRP Update.

Followup Actions

Representatives of the NRC staff agreed to provide the Subcommittee copies of the following documents:

- A list of documents including those which are applicable but are not necessarily referenced
- NUREG/CR-6101, "Software Reliability and Safety in Nuclear Reactor Protection Systems," November 1993

Background Material Provided to the Committee for this Meeting

- Letter dated January 3, 1996, from J. Taylor, EDO, to Chairman Jackson, NRC, Subj: "Improvements Associated With Managing the Utilization of Probabilistic Risk Assessment (PRA) and Digital Instrumentation and Control Technology"
- Letter dated November 30, 1995, from Chairman Jackson, NRC, to J. Taylor, EDO, Subj: "Follow-up Requests in Probabilistic Risk Assessment and Digital Instrumentation and Control"
- Draft Version 3.0, Standard Review Plan, Section 7.0, "Instrumentation and Controls - Overview of Review Process," dated February 12, 1996
- Proposed Version 9.0, Branch Technical Position HICB-14: "Guidance on Software Reviews for Digital Computer-Based Instrumentation and Control Safety Systems," dated February 14, 1996
- Draft Version 7.0, Standard Review Plan, Section 7.1, "Instrumentation and Controls - Introduction," dated February 14, 1996
- Revised Schedule - Chapter 7 SRP

March 6, 1996

- Memorandum from W. Hodges, RES, to J. Larkins, ACRS. Subj: "Drafts of New Regulatory Guides on Software Used in Safety Systems of Nuclear Power Plants for ACRS Reviews," forwarding two draft regulatory guides endorsing four industry standards
- Draft Regulatory Guide DG-XXXX, Version 2.7.2, Verification, Validation, Reviews, and Audits, for Digital Computer Software Used in Safety Systems of Nuclear Power Plants"
- Draft regulatory Guide DG-XXXX, Version 2.0.7, Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants"
- IEEE-Std. 1012-1986, "IEEE Standard for Software Verification and Validation Plans"
- IEEE Std. 1028-1988, "IEEE Standard for Software Reviews and Audits"
- IEEE Std. 828-1990, "IEEE Standard for Software Configuration Management Plans"
- ANSI/IEEE Std. 1042-1987, "ANSI/IEEE Guide to Software Configuration Management"
- Memorandum dated January 30, 1996, from F. Miraglia, NRR, to E. Jordan, CRGR, Subj: Request for Endorsement of the Safety Evaluation Report on Electric Power Research Institute Topical Report, TR-102323, "Guidelines for Electromagnetic Interference Testing in Power Plants" (M91235)
- 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," dated April 26, 1995

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NOTE: Additional details of this meeting can be obtained from a transcript of this meeting available in the NRC Public Document Room, 2120 L Street, N.W., Washington, D.C. 20006, (202) 634-3274, or can be purchased from Neal R. Gross & Co., Inc., Court Reporters and Transcribers, 1323 Rhode Island Avenue, N.W., Washington, D.C. 20005, (202) 234-4433.