DIGITAL I&C AND CONTROL ROOM LICENSING ISSUES WORKSHOP SRP UPDATE

March 28, 2006

Allen G. Howe, Chief
Instrumentation and Controls Branch
Division of Engineering

Standard Review Plan Update Status

Instrumentation and Controls Standard Review Plan (SRP), NUREG-0800, sections are scheduled for update based on new reactor licensing priorities.

- 5 Priority 1 (needed to support Combined Operating License application preparation) Instrumentation and Controls SRP sections (sections, appendices, tables and branch technical positions)
  - Technical Update* May 2006 through July 2006
  - Final Issue January 2007 through April 2007
- 21 Priority 2 (needed to support license application reviews) Instrumentation and Controls SRP sections
  - Technical Update* November 2006 through April 2007
  - Final Issue September 2007
- 15 Priority 3 (administrative update) Instrumentation and Controls SRP sections
  - Technical Update* October 2007
  - Final Issue September 2008

Standard Review Plan Update Status (Continued)

Priority 1 SRP Updates

Appendix 7.1-C	Guidance for Evaluation of Conformance to IEEE Std 603
Appendix 7.1-D	Guidance for Evaluation of Conformance to IEEE 7-4.3.2
Section 14.3.5	Instrumentation and Control (Tier 1) ITAAC
BTP 7-14	Guidance on Software Reviews for Digital Computer-Based Instrumentation and Control Systems
BTP 7-16	Guidance on the Level of Detail Required for Design Certification Applications Under 10 CFR Part 50. (BTP 7-16 will be updated in parallel with the drafting of the regulatory guide for Combined Operating License Applications, DG-1145)

* A Technical Update is defined as signed by the technical division director prior to issuance for public comments

DIGITAL I&C AND CONTROL ROOM LICENSING ISSUES WORKSHOP

March 28, 2006

Allen G. Howe, Chief
Instrumentation and Controls Branch
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CHALLENGES FOR NRC

- NRC is facing a significant increase in workload on digital applications with multiple COL applications, design certifications, digital upgrades of operating plants
- Digital reviews require significant effort
- New technology and new technical issues will require time and effort to review and develop basis for safety approval
- Need for clarity on the level of design details of I&C system provided for COL approval, vs. the review of the I&C system during via ITAAC
- Cyber security

NRC DIGITAL REVIEW PROCESS

- NRC reviews the system design and the software development process
- The review depends, to a large extent, on confirming that licensee's employ a high-quality development process that incorporates disciplined specification and implementation of design requirements
- Our review contains elements similar to the V&V effort, but does not duplicate it
- We review the inspection and testing used to verify correct implementation and to validate desired functionality of the final product
- A typical safety evaluation is a detailed review of the system design process and the software V&V program, with a programmatic look at the design process.

NRC DIGITAL REVIEW PROCESS (Continued)

- We review the:
  - system specifications
  - system design
  - hardware and software specifications
  - V&V Program
  - software and hardware history
  - coding standards
  - software and hardware systems review for timing or software / hardware interface problems
  - test program and test results
  - qualifications of the personnel who designed the system and those who did the V&V

NRC DIGITAL REVIEW PROCESS (Continued)

- Our review includes a thread audit of sample plant parameters
- NRC also reviews the specific application including any special features that required V&V Review
- The detailed review of the specific software V&V:
  - is evaluated following the code development
  - examines the vendor/licensee interface and feedback process
  - reviews the software problem/error reports and resulting corrections
  - reviews the V&V process by interviewing personnel involved in the process

DIGITAL I&C SYSTEMS REVIEW ISSUES

- Adequacy of diversity and defense-in-depth, or unique method of D3
- Unusual or new architecture
- Use of LANs in safety system
- GDC-24, separation of protection and control systems
- 1st time use of hardware or software
- Doing things right, but without adequate documentation

REASONS FOR THE REVIEW ISSUES

- Complexity
  - Software is highly complex
    - No methods to predict failure rates - therefore it is difficult to determine risk
    - Software can't be proven error free - therefore a high quality design process provides assurance that the system functions as intended
  - Hardware - microprocessors are often as complex as software
    - Hardware component use is not plant or nuclear specific, so potential problems may be known through other use

REASONS FOR REVIEW ISSUES (Continued)

- Design Process - complex, detail oriented, expensive, and slow
- Waterfall model of design
  - the outputs of each stage in the design process are complete and verified prior to using those products as inputs to the next stage in the design
- Spiral or rapid prototyping method of design
  - allows use of incomplete or unverified outputs as inputs to the next phase
  - more difficult to show of high quality design

WHAT DO WE NEED FOR A SUCCESSFUL REVIEW?

- Documentation of completed design - in process reviews will require the review of the same item in various revisions, and will take significantly more effort
- Demonstration of high quality via complete and accurate documentation and evidence of a rigorous design process implementation
- To the degree the design can be simplified, the design can be understood easier and reviewed faster
- Demonstration of V&V - this is a key issue, and will be closely examined
- Demonstration of testing - the testing needs to br rigorous enough to test every requirement

WAYS LICENSEES CAN HELP THE STAFF APPROVE DIGITAL I&C SYSTEMS

- Early and frequent interactions with the NRC staff
- Early identification of new concepts and technology - this will assist in getting the issues into the resolution process
- Submit system designs that are substantially completed
- Have all the documentation ready. Figure 7.0-A-5 of the SRP shows what the staff will need for the review
  - All documents should be the final approved version
  - Installation documentation will not be available until the plant is built
- Anticipate RAI questions and provide the answers in the original submittal
  - A significant percentage of RAI questions are the same for each review
  - Elimination of RAI's can speed up the review process significantly

WAYS LICENSEES CAN HELP THE STAFF (Continued)

- Use technology, methods and justification that are addressed by current review methods. A new staff position on new concepts will take time.
  - Balance the advantages of new concepts with the risk - it may be that the gain is worth the additional time and effort
  - Topical Reports on new concepts may be appropriate
- Use what has been approved before (Design Centered Approach)
  - Review effort for the second use of an I&C system significantly reduced
  - This assumes a virtually identical system - differences will require additional NRC review

CONCLUSION

The next few years will be very challenging for both the NRC and for licensees. We will need to work together to meet these challenges.

DIGITAL I&C AND CONTROL ROOM LICENSING ISSUES WORKSHOP REGULATORY GUIDANCE FOR NEW REACTOR LICENSING

(Given at 2006 RIC)

March 28, 2006

Joseph Colaccino
New Reactor Licensing Branch
Division of New Reactor Licensing

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DG-1145: COL Applications for Nuclear Power Plants (LWR Edition)

- NRC engaged NEI COL Task Force in 2005 on NEI 04-01, *Draft Guideline for Combined License Applicants Under 10 CFR Part 52*
- NEI 04-01 covers the base case - COL applications referencing a certified design and an early site permit (ESP)
  - No announced COL applicants have proposed to follow the NEI 04-01 base case
- COL applicants have requested to engage NRC staff on:
  - COL application contents
  - what questions the NRC staff is likely to ask for each chapter of the SAR during the review of a COL application

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Format of DG-1145

- Part I: Format and Content of a COL application
  - Information required by revised 10 CFR 52.79
  - Based on RG 1.70, Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (Light-Water Reactor Edition)
- Part II: Supplemental Information
  - Information required by revised 10 CFR 52.80
  - Probabilistic Risk Assessment
  - Environmental Report
- Parts I and II constitute the complete set of information needed for a COL application, regardless of whether it references a certified design, ESP, both, or neither

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Format of DG-1145 (continued)

- Part III: COL applications referencing a certified design and an ESP
  - road map for identifying finality for COL applications
  - identifies the portions of a COL requiring review
- Part IV: Everything else
  - change processes
  - operational programs
  - other topics
- Full draft "Table of Contents" is on NRC website

http://www.nrc.gov/reactors/new-reactor-licensing.html

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Development of DG-1145

- Draft sections of DG-1145 will be made available on NRC website as "draft work-in-progress"
- NRC will engage public prior to issuance of DG-1145 in three public workshops
  - March 15 – 16
  - April 20 – 21
  - June 5 – 6
- DG-1145 to be issued for comment in June '06
- Additional public workshops scheduled for July 2006
- Comments may be made anytime after document is placed on the NRC website

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Standard Review Plan (NUREG-0800) Update

- Approximately 290 SRP Sections (including Branch Technical Positions)
- Certain SRP sections to be updated by 2007 to support COL applications
  - High priority SRP sections (20%)
  - Medium priority SRP sections (65%)
  - Remaining low priority SRP sections are not scheduled to be updated within the next 2 years
- Staff considering risk-informing the prioritization and scheduling of the updates
- The SRP update schedule is available at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/

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Standard Review Plan Update (continued)

- High priority SRP sections
  - new or existing sections providing guidance related to new reactor licensing (e.g., Section 14.3 on ITAAC);
  - sections addressing operational programs (including industry identified sections);
  - sections with inconsistent technical guidance; and
  - site-specific sections addressed in RS-002, "Processing Applications for Early Site Permits."
- Medium priority SRP sections
  - design-related sections used in previous design certification reviews
  - ensure that the most up-to-date review guidance is referenced

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Summary

- NRC is preparing for a large number of COL applications in 2007-2008 time frame
- NRC can perform COL application reviews using existing guidance
- NRC is responding to industry requests and new reactor licensing preparation activities by:
  - updating the applicable guidance for use by COL applicants in development of their applications
  - updating acceptance criteria for use by staff to efficiently perform COL application reviews
- For more information, visit our website:
  - http://www.nrc.gov/reactors/new-reactor-licensing.html
  - http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/

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DIGITAL I&C AND CONTROL ROOM LICENSING ISSUES WORKSHOP WHAT YOU NEED TO KNOW ABOUT ITAAC (GIVEN AT 2006 RIC)

March 28, 2006

Joseph Colaccino
New Reactor Licensing Branch
Division of New Reactor Licensing

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What is an ITAAC?

- Inspections, tests, analysis and acceptance criteria
- Provision to a combined license
- Successful completion of all ITAAC demonstrates that plant constructed in accordance with the atomic energy act, the regulations, and the license

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Format of an ITAAC

Design commitment
- Key features from design basis

Inspections, tests and analyses
- What observations, tests or examinations will be done to determine if the commitment was met?

Acceptance Criteria –
- taken from assumptions in Safety Analysis

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How does an ITAAC work?

- The list of ITAAC are submitted with the COL application.
- NRC reviews and approves the ITAAC and incorporates them as part of the license.
- NRC inspectors watch the licensee perform ITAAC-related activities during construction.

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Not all ITAAC are created equal

Design Commitment	Inspection Test Analysis	Acceptance Criteria
Safety related displays in the main control room can be retrieved	Simple inspection	Safety related displays can be retrieved in the main control room
ASME code piping retains pressure boundary integrity at design pressure	Report demonstrating piping meets ASME code	A report exists and concludes that piping meets requirements of ASME code

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Closing an ITAAC

- The licensee informs the NRC when each ITAAC has been met
- NRC reviews ITAAC closeout letters:
  - Licensing performs acceptance review
  - Region examines inspection record for that ITAAC
  - Licensing documents the basis for the ITAAC acceptance criteria being successfully met
- A notice is published in the *Federal Register*

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Optional Hearing

- Notice of intended operation published in *Federal Register* 180 days before scheduled fuel load
- Any person whose interest may be affected by operation of the plant can request a hearing

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Optional Hearing (cont'd)

- Hearing granted if prima facie evidence supports:
  1. One or more ITAAC acceptance criteria have not or will not be met
  2. Operational consequences of nonconformance contrary to providing reasonable assurance of adequate protection

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When does it end?

- When the NRC concludes that all of its inspection of ITAAC are complete,
- When all of the Federal Register Notices are published, and
- When the Commission makes a finding in accordance with 10 CFR 52.103(g) and fuel is loaded
  - Condition of license satisfied

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Licensee ITAAC Closeout Letter Content

- Industry Position: Roadmap for successful ITAAC completion available at plant site but not on docket
- NRC Position: Closeout letter provides references to upper tier documents that form basis for successful ITAAC completion
  - NRC will provide basis for successful ITAAC completion in the *Federal Register* notice
  - NRC letter dated November 21, 2005, provides examples of information that would satisfy NRC position

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DIGITAL I&C AND CONTROL ROOM LICENSING ISSUES WORKSHOP NRC DIGITAL SYSTEM RESEARCH

March 28, 2006

William E. Kemper, Branch Chief
Instrumentation and Electrical Engineering Branch
Division of Fuel, Engineering, and Radiological Research

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CURRENT SITUATION

- *Licensees are replacing analog systems with* digital systems as the existing analog systems reach obsolescence
- Licensing these digital systems presents challenges because of
  - Increased complexity of the systems
  - Significant effort required by staff with specialized skills
  - Limited operating history of digital equipment in nuclear safety-related applications
  - Potential new failure modes
  - Consolidation of many analog functions into a single digital system

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CURRENT SITUATION

- *Industry operating history indicates that digital* system failures may be risk significant
  - 1984-1997 ASP data indicated that a large number of the risk significant events included I&C failures and that both safety and non-safety I&C system failures contributed to these events
  - Review of LER data reveals that many software system failures are system state-dependent and that many faults are introduced in testing, operations, and maintenance
  - Evidence of potential problems (Palo Verde Core Protection Calculator, Turkey Point load sequencers, BWR OPRMs, etc.) is abundant

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CURRENT NRC SITUATION

- The current digital system review guidance (SRP Chapter 7) is several years old (1997)
- Current licensing guidelines provide information on what to review, but need updating to reflect current knowledge and industry experience with digital systems
- There is industry interest in risk-informed digital system reviews; however, the technical bases to either approve or reject applications of this kind *must be developed*

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RESEARCH FOCUS

- Structured to include the most important research areas needed to support the program offices
- 27 projects across 6 Research Programs
  - Systems Aspects of Digital Technology
  - Software Quality Assurance
  - Risk Assessment of Digital I&C Systems
  - Security Aspects of Digital Systems
  - Emerging Digital Technology and Applications
  - *Advanced Nuclear Power Plant Digital Systems*

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RESEARCH FOCUS

- Broad-based, focusing on improving traditional review methods for
  - Reviewing existing digital technologies
  - Analyzing emergent technologies
  - Evaluating issues arising from the application of digital technologies
- Oriented toward providing more consistent processes for regulating nuclear applications
  - Technical guidance to the staff
  - Regulatory-based objective acceptance criteria
  - Assessment tools and methodologies for the staff
  - Review and inspection procedures
  - Staff training

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PRIORITIES FOR CONDUCTING THE RESEARCH

- Balanced between
  - Current regulatory issues (e.g., EMI/RFI, D3, Security)
  - Issues that are anticipated to be regulatory issues in the short term (e.g., FPGAs, OLM, digital system risk, new reactor design issues)
  - Emerging technology that might require future licensing reviews (e.g., smart transmitters, self testing methods)

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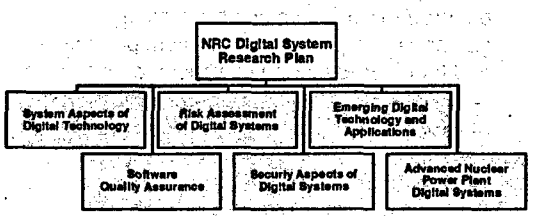
RESEARCH PROGRAMS



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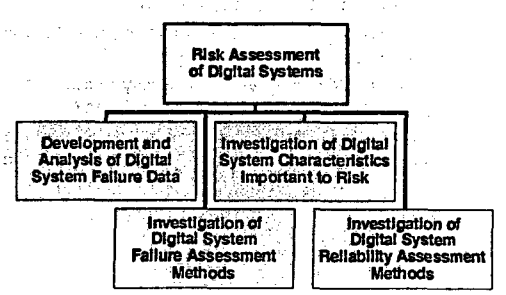
RISK ASSESSMENT OF DIGITAL SYSTEMS



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DIGITAL SYSTEM RISK PROGRAM

- Licensing digital systems using risk insights presents challenges
  - Industry has expressed interest in incorporating risk insights in the reviews of these systems or using risk-informed regulation as an alternate method for licensing these systems (e.g., EPRI Topical Report)
  - NRC regulatory guidance does not currently support use of quantitative reliability analysis in digital system reviews

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DIGITAL SYSTEM RISK PROGRAM

- Licensing digital systems using risk insights presents challenges
  - Lack of a generally accepted methodology to predict digital system (hardware and software) failure probability
  - Lack of a generally accepted methodology for inclusion of digital system reliability models in current generation PRAs
  - Research into the limitations of digital systems reliability modeling needs to be completed for NRC to support expanded use of risk information in licensing digital systems

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DIGITAL SYSTEM RISK PROGRAM

- Additionally as NRC licensees replace analog systems with digital systems, the current PRAs are not keeping up with these changes
- NRC does not have the tools or procedures to complete these kinds of reviews. NRC risk guidelines do not provide acceptance criteria for digital system reviews
- The NRC research program is designed to resolve these issues and develop guidance and tools needed to implement a more risked informed digital system review process

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DIGITAL SYSTEM RISK PROGRAM

- The research program seeks to address the following unresolved technical issues
  - What are acceptable reliability modeling methods and potential problems for modeling digital systems?
  - What data is needed to support these modeling methods?
  - What level of detail is needed for the modeling of digital systems and can some systems be modeled at a higher level based on their risk importance, their failure modes, and/or their interactions with other systems?

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DIGITAL SYSTEM RISK PROGRAM

- Unresolved technical issues (cont)
  - How should digital system common mode failures be modeled
  - How should digital system reliability models be integrated into current generation PRAs?
  - What additions/modifications need to be made to current NRC risk informed regulatory guidance to accommodate risk informed digital system reviews?

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DIGITAL SYSTEM RISK PROGRAM

- The digital system research program is oriented toward developing regulatory guidance and providing consistent processes and tools for reviewing risk based applications
  - Gathering, understanding and using failure data
  - Assessing what modeling methods are acceptable
  - Determining which digital systems need to be modeled and at what level of detail
  - Developing and testing modeling methods
  - Developing regulatory guidance
  - Developing regulatory acceptance criteria

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DIGITAL SYSTEM RISK PROGRAM

Status and Schedule

- RES has completed its review of available methods and tools for including digital system models into PRAs (NUREG/CR-6901 and other studies) and is investigating the most promising ones in detail
  - Report on available methods and tools for including digital system models into PRAs (NUREG/CR-6901) was published in March 2006
  - Pilot analyses using both traditional methods and dynamic methods for modeling digital I&C systems are in process
    - Develop NRC analysis capability
    - Highlight the capability and limitations of the various methods
    - Develop a better understanding of data requirements
    - Support regulatory guidance development
  - Draft Regulatory Guidance is being prepared
    - Workshop (~June 2006)
    - Draft for comment (~October 2006)

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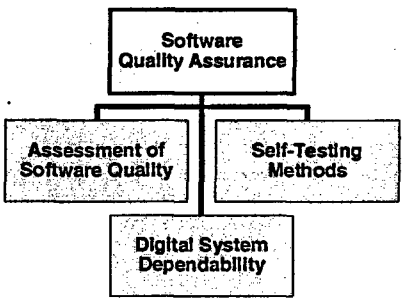
SOFTWARE QUALITY ASSURANCE



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SOFTWARE QUALITY ASSURANCE

- NRC SRP Chapter 7, Rev. 4, June 1997 provides regulatory guidance for reviewing digital safety systems
- As part of its review of digital safety systems, NRC evaluates safety related software quality by reviewing
  - System and software specifications
  - Development processes (e.g., V&V, CM) and
  - Software development products (e.g., SRS, SDD, Test plans, Code listings, RTM, test procedures)

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SOFTWARE QUALITY ASSURANCE

- SQA evaluations are performed manually, since automated assessment tools or other means of obtaining quantitative measures of software quality are not available
  - Time consuming
  - Highly dependent on the skill and experience of the individual reviewer
  - Acceptance criteria often is qualitative instead of quantitative

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SOFTWARE QUALITY ASSURANCE

- The current state-of-the-art in software system safety assessment includes a number of methods and tools for objectively assessing the quality of software
  - Software system analysis techniques (e.g., Petri-net analysis, Markov Analysis, Dynamic Flow Modeling)
  - Software metrics
  - Testing Techniques (e.g., Data Flow Testing, Fault Injection, and Mutation Testing)
- None of the these methods have found wide-spread acceptance

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SOFTWARE QUALITY ASSURANCE

- Given the complexity and sophistication of current digital safety systems, the goal of research in this area is to provide independent assessment methods and specific acceptance criteria that can supplement and augment the existing guidance in Chapter 7 of the SRP

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SOFTWARE QUALITY ASSURANCE

- Research in this area will focus on methods that have likely short term application without the need to do extensive development
  - Fault injection testing has been used by a number of industries including some nuclear platform suppliers to ascertain system dependability
  - Software metrics are currently used for software quality control and continuous improvement (e.g., for programs at CMM level 4 and 5 respectively)

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SOFTWARE QUALITY ASSURANCE

- Ongoing projects include
  - Dependability testing of systems important to safety (e.g., Digital Feedwater Control System) using Fault Injection methods
  - Estimation of reliability using lifecycle metrics on safety related (SR) RPS modules
- Future projects include
  - Dependability testing of SR NRC approved COTS safety systems using Fault Injection methods
  - Develop review criteria for evaluating self-testing features of digital systems
  - Updating/automating software development review tools

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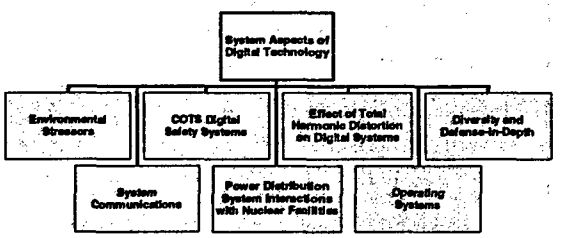
SYSTEM ASPECTS OF DIGITAL TECHNOLOGY



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SYSTEM ASPECTS OF DIGITAL TECHNOLOGY

- System aspects of digital technology involve factors, both internal and external, that affect the performance of a digital system as a whole
- This research will address aspects of digital systems that can adversely affect safety due to
  - Environmental stressors
  - Systems interactions associated with power distribution and total harmonic distortion effects
  - Operating systems
  - System communications
  - Common mode failures (i.e., Diversity and defense-in-depth)

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SYSTEM ASPECTS OF DIGITAL TECHNOLOGY

- Ongoing projects include
  - Review of CS-114,High Freq. conducted susceptibility limits (TR-102323) for possible revision of RG 1.180
  - Development of DG-1124 (DG 1077) for EQ of microprocessors in mild environment
- Future projects include
  - Evaluate/identify communication system failure mechanisms and mitigation strategies
  - Evaluate safety implications of system interactions associated with power fluctuations and THD
  - Evaluate safety critical aspects of operating systems

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SYSTEM ASPECTS OF DIGITAL TECHNOLOGY

- Future projects include (cont'd)
- Verify existing D3 position and guidance (SRP BTP HICB-19) is realistically conservative
  - Evaluate NUREG/CR-6303 coping strategies
  - Perform case studies of digital safety system configurations to evaluate their susceptibility to CMF
  - Evaluate the fault injection process as a methodology for identifying CMF vulnerabilities

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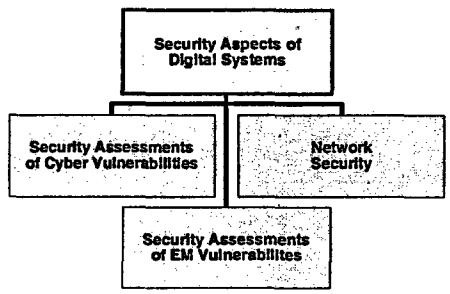
SECURITY ASPECTS OF DIGITAL SYSTEMS



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SECURITY ASPECTS OF DIGITAL SYSTEMS

- Cyber security is an NRC concern that has been heightened since the events on 9/11
- Projects are being initiated In support of NUREG/CR-6847, Cyber Security Self-Assessment Method for U.S. NPPs
- Projects include
  - In-Lab Security Assessment of digital platforms
  - Site-specific protocol analysis
  - Secure network design techniques
  - EM vulnerability of digital systems in NPPs

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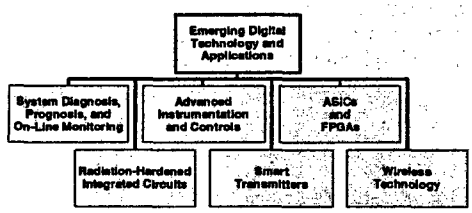
EMERGING DIGITAL TECHNOLOGY AND APPLICATIONS



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EMERGING DIGITAL TECHNOLOGY AND APPLICATIONS

- Vendors, licensees, and owners groups likely will continue to develop and propose new technologies for nuclear facilities
- A detailed understanding of these emerging technologies is critical for NRC staff to license these technologies in safety related applications in an effective and consistent manner
- This part of the research program will include an effort to identify important emerging technologies that may have a regulatory impact

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EMERGING DIGITAL TECHNOLOGY AND APPLICATIONS

- As an example, application specific integrated circuits (ASICs) and field programmable gate arrays (FPGAs) are now starting to be used in safety applications
- FPGAs are currently being used by Toshiba in safety systems for international nuclear applications
- ASIC and FPGA scope of reviews must be concentrated on hardware and design tools in addition to software products

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EMERGING DIGITAL TECHNOLOGY AND APPLICATIONS

- This research will
  - Evaluate the safety aspects (design, V&V, etc.) of ASICs and FPGA based digital systems
  - Develop safety assessment techniques and acceptance criteria for these devices
  - Support modifications of current regulatory guidance (SRP) to include this emerging technology

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EMERGING DIGITAL TECHNOLOGY AND APPLICATIONS

- Ongoing projects include
  - Emerging technology evaluations (every 2-4 years)
  - On-line monitoring at NPPs
  - Deployment of Wireless technology at NPPs
- Future projects include
  - System diagnosis and prognosis
  - Advanced instrumentation and controls at current NPPs
  - Radiation-hardened integrated circuits
  - ASICs and FPGAs
  - Smart transmitters

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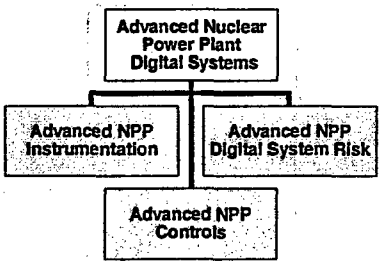
ADVANCED NPP DIGITAL SYSTEMS



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ADVANCED NPP DIGITAL SYSTEMS

- Advanced (new) reactor designs may apply new I&C technologies in safety systems, systems important to safety, and non-safety systems
  - *Fully integrated DCS, new system architectures* (displays, soft controls,etc), new instrumentation, new HSIs, artificial intelligence, autonomous controls, etc.
- These advanced reactor I&C designs could present new regulatory challenges

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ADVANCED NPP DIGITAL SYSTEMS

- The level of detail provided to date is not adequate for identifying specific research programs needed to develop new technical licensing bases for these designs
  - EPR
  - AP1000
  - ESBWR
  - PBMR
  - ACR-700
- Some Vendors are working to provide additional information associated with open issues from Design Certifications and to prepare for COL reviews

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ADVANCED NPP DIGITAL SYSTEMS

- Research projects are dependent on the amount of information in advanced (or new) reactor design certifications, pre-application reviews and COL applications
- Research will be organized into three basic areas
  - Advanced nuclear power plant instrumentation
  - Advanced nuclear power plant protection and control systems (including digital control rooms)
  - Advanced nuclear power plant digital system risk
- No research in progress at this time

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SUMMARY

- The goal of NRC research is to provide a flexible, adaptable framework for supporting NRC regulatory requirements
  - Broad-based program oriented toward providing more consistent processes for regulating nuclear applications
  - Will provide improved review methods for new applications of existing technologies, advanced technologies and new issues
  - Will result in development of regulatory acceptance criteria
- The NRC Digital Safety System Research Plan should be published in April 2006.

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