



## **I&C Regulatory Issues for New Plants and Related EPRI I&C Activities**

**Joseph Naser**

**EPRI / NEI Digital I&C and Control Room Licensing Issues Workshop**

**March 28 - 29, 2006  
Washington D.C.**

### **Background - Committee on New Construction Meeting November 15, 2005**

- **David Mathews, NRC Director of New Reactor Licensing, pointed out that:**
  - **New plant activities are going to be a bigger effort for NRC than license renewal and require greater resources (expect between 8 and 14 COLs in FY2008)**
  - **After design acceptance certification, there are still many open items mostly in the areas of I&C, human factors, and control rooms (earlier in the week another NRC representative estimated that 40% of the designs are still open items from the NRC reviewer perspective)**
  - **To get through the licensing process, applicants and suppliers need to work together to:**
    - **Develop generic solutions for a given reactor type**
    - **Submit them as a topical report early rather than waiting for individual applications**
  - **Common solutions will get higher attention by NRC**

## Background - Nuclear Energy Overview February 27, 2006

- Statements by Laura Dudes, NRC Branch Chief for new reactor licensing, and Phillip Ray, NRC senior project manager for new reactor licensing
- Current schedules indicate that COL applications will be submitted for 12 to 19 reactors within the next 2 years
- NRC emphasized that effectiveness of standardized review approach will rest heavily on industry's ability to:
  - Commit to standardization
  - Submit high-quality applications that are as complete as possible
- NRC asked industry to organize vendor/applicant coordinating groups for each reactor design type
- Identify one of the COL applications to serve as the reference COL
- Subsequent COL applications cite reference COL
- NRC urged industry to use topical reports to resolve issues generically (by design) ahead of application submittals

## Background (Cont'd)

- Conclusion taken from these statements is that if new plants are to be successfully licensed in a timely manner (and to reduce licensing costs and risks), work on I&C, human factors, and control room issues needs to move forward now to develop effective, generic solutions that can be submitted as topical reports for review before individual plant applications are submitted
- The approach of industry working together to develop generic solutions was presented at the New Plant Deployment APWG meeting on November 30, 2005
- The concept was endorsed at that meeting
- Understanding that most of the issues requiring solution apply to both new plants and to existing plants modernizing with digital equipment

## EPRI/NEI Digital I&C Workshop

- Workshop objectives
  - Establish dialogue between utilities, vendors, suppliers, and regulators to fully identify and prioritize specific generic I&C issues and discuss candidate resolution strategies
  - Agree on consensus direction for next steps including commitment for utility, vendor, supplier, NEI, INPO, and EPRI participation

## Straw Man Starting Point for Issues Discussion

1. Licensing digital control rooms
  - Minimum inventory of fixed position and continuously available indicators and controls
  - Technical and regulatory requirements appropriate for qualified HSIs for accident mitigation, display evaluation, soft controls, computerized procedures, automation, etc.
  - Criteria to assure appropriate teamwork between operating crew members and between automation and operators?
  - Types of verification and validation appropriate for HF features, and how should their scope and rigor be graded based on complexity and/or safety significance and/or other criteria
2. Licensing distributed control system architectures
  - Separation of safety and non-safety systems - inter-channel communications
  - Separation/diversity of RPS and ESFAS
  - New communications technologies such as wireless and fieldbus

## Straw Man Starting Point for Issues Discussion

3. Failure management for new HSIs
  - Practical criteria and methods are needed for addressing partial or large-scale failures of the HSIs
    - Appropriate operation under degraded HSI conditions
    - What backups should be provided and when to switch to them
    - Integration of backups into overall control room design
4. Combined safety/non-safety HSIs
  - Single HSI for both safety and non-safety equipment
  - Protection of safety functions against hardware and software failures in non-safety equipment
  - Criteria for "priority logic" modules to ensure that equipment will always respond correctly to conflicting instructions
  - Not a single point of failure that can disable the safety function entirely

## Straw Man Starting Point for Issues Discussion (Cont'd)

5. Graded approaches for HFE analysis and V&V
  - Mentioned in NRC guidance but no definitive approach on how
  - Not using graded approaches is potentially a large cost contributor and using them is an area of licensing risk
6. Defense-in-depth and diversity (D3)
  - Increased concern regarding potential for digital common-cause failures, including software failures, to disable redundant safety channels or multiple systems that use identical programmable platforms or identical software modules
7. Application of risk-informed methods to I&C
  - Risk informed approaches would be particularly useful in D3 evaluation to determine where it makes sense to add backups
  - Indications that use of a risk-informed approach or risk insights in D3 evaluation will require significant additional review time
  - NRC accepted approach would help plants (and NRC) focus resources on the most safety-significant areas

## Straw Man Starting Point for Issues Discussion (Cont'd)

### 8. Modeling digital equipment in PRA

- No consensus on how digital equipment could or should be modeled in PRA

### 9. Cyber security

- NEI 04-04 provides high-level, programmatic "what-to-do" guidance
- Regulatory requirements and acceptance criteria not well defined
- Wireless technology adds another dimension

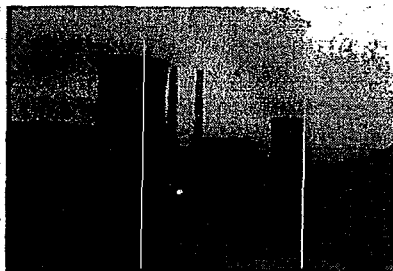
### 10. Out of date review criteria for digital equipment

- Review criteria for digital systems are changing; NRC is in the process of updating several sections of SRP Chapter 7 and associated BTPs
- What are the criteria for new plants?
- What are acceptable approaches to satisfy the criteria?

## Straw Man Starting Point for Issues Discussion (Cont'd)

### 11. Emerging technologies

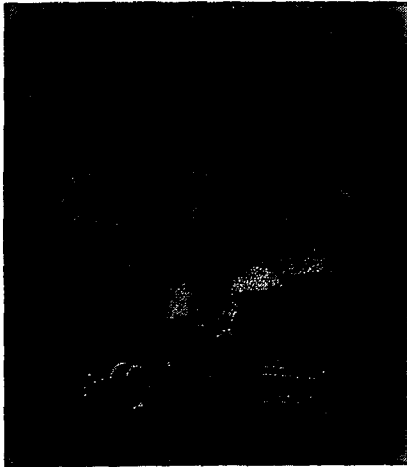
- New technologies such as FPGAs or ASICs
- No industry guidance on requirements or acceptance criteria for use in safety applications currently exists



## Straw Man Starting Point for Issues Discussion (Cont'd)

12. Changing and undocumented regulatory positions
- Recent questions and comments from NRC staff suggest that previously established regulatory positions and guidance on key issues related to I&C modernization may be changed or reinterpreted or applied differently in the future
    - Defense-in-depth and diversity
    - Separation/diversity of RPS and ESFAS
    - Inter-channel communications
    - Reevaluation of approved platforms
    - New interpretation of common-cause failure criteria
  - What are the NRC positions?

## EPRI I&C Program Activities



- EPRI has been doing a substantial amount of work and providing leadership in the areas of I&C, human factors, and digital control rooms for the modernization of existing plants and much of this work will help new plants in these areas
- This expertise can support the industry in developing generic and effective solutions that will support the goals for each of the new plant designs

## EPRI Guidelines

- "Guideline on Licensing Digital Upgrades", EPRI TR-102348, December 1993
  - Response to 1992 draft GL that said digital upgrades were automatic USQs
  - Industry working group led by EPRI and NEI
  - NRC withdrew draft GL and issued GL (95-02) endorsing this
- "Guideline on Licensing Digital Upgrades TR-102348 Revision 1, NEI 01-01: A Revision of EPRI TR-102348 to Reflect Changes to the 10 CFR 50.59 Rule", EPRI 1002833, March 2002
  - Update to reflect new 50.59 rule
  - Industry working group led by EPRI and NEI
  - Published as EPRI and NEI reports
  - NRC issued a RIS endorsing it

## EPRI Guidelines (Cont'd)

- "Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications", EPRI TR-106439, October 1996
  - Commercial dedication of digital equipment
  - EPRI led industry working group
  - NRC issued SER on this
  - Referenced in SRP as NRC opted to endorse this rather than write BTP on this subject
- "Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety Related Applications in Nuclear Power Plants", EPRI TR-107330, December 1996
  - EPRI led industry user group
  - NRC approved this in an SER
  - Basis for qualifying PLC platforms (Common Q, Teleperm XS, Tricon) and getting SERs on them

## EPRI Guidelines (Cont'd)

- "Guidelines for Electromagnetic Interference Testing of Power Plant Equipment: Revision 3 to TR-102323", EPRI – 1003697, November 2004
  - Earlier version of this guideline
    - EPRI led industry working group
    - NRC issued SER on this
  - 2004 version provided to NRC Research to support their effort to update Reg. Guide 1.180 R1

## EPRI Guidelines (Cont'd)

- "Guidelines for Performing Defense-In-Depth and Diversity Assessments for Digital Upgrades: Applying Risk Informed and Deterministic Methods", EPRI – 1002835, December 2004
  - EPRI led industry working group
  - D3 guidelines submitted to NRC under NEI cover letter in February 2005
  - Basis for developing industry positions on
    - D3
    - Software common cause failure
    - RPS and ESFAS on same platform
    - Communication between safety and non-safety systems
    - Etc.



## EPRI Guidelines (Cont'd)

- “Human Factors Guidance for Control Room and Digital Human-System Interface Design and Modification: Guidelines for Planning, Specification, Design, Licensing, Implementation, Training, Operation, and Maintenance”, EPRI – 1010042, December 2005
  - EPRI led industry working group
  - Technical bases for regulatory positions on
    - Large-scale HSI failures - minimum inventory indicators / controls
    - Digital solutions for safety monitoring and controls
    - Combined safety/non-safety HSIs
    - Qualified HSIs
    - Level of qualification for different HSIs
    - Graded approach to HFE
    - Teamwork between operators or automation and operators
    - Etc.

## Suggested Approach for Generic Resolution of Critical Issues

- Industry working group to generically address each critical issue
- Where possible treat issue generically to apply to all three plant types
- When necessary treat generically for a plant type
- Working groups consist of all industry stakeholders
  - Utilities
  - Vendors and suppliers
  - NEI
  - EPRI

## Suggested Approach for Generic Resolution of Critical Issues (Cont'd)

- Generic solutions, in most cases, will be developed by
  - Identification of failure modes
  - Develop and document industry positions/guidance/technical bases, rather than developing a specific design
- Solutions based on results available from EPRI, vendors and suppliers, and utilities, and from NRC guidance and regulations
- Not research projects to develop solutions – need solutions in a timely manner to support COL applications
- This approach will allow an industry-wide solution that can be submitted to the NRC for acceptance

## Suggested Approach for Generic Resolution of Critical Issues (Cont'd)

- Approach can then be used for all three plant types to develop plant-type specific design
- Exception could be for an issue that is strictly related to a single plant type
  - Here it may still be appropriate to develop industry positions/guidance/technical bases, or it may be better to develop the actual design

## Proposed Working Relationship between Industry and NRC

- Early and frequent discussions between Industry and NRC
- NRC participate informally on the working groups so that NRC concerns and issues are taken under consideration when the solutions are being developed rather than having these concerns and issues identified after the solution is developed
- Lead to better solutions that will support both NRC and industry needs
- Reduce time and risk for developing and obtaining acceptance of solutions

## We Need to Work Together to Succeed



**QUESTIONS?**