October 14, 2005

MEMORANDUM TO: William M. Dean, Assistant for Operations
Office of the Executive Director for Operations

FROM: Charles E. Ader, Director ***/RA/ A. Rubin for***
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

SUBJECT: PRESENTATIONS AT THE SIXTH ANNUAL MEETING OF THE NEA/CSNI WORKING GROUP ON RISK ASSESSMENT (WGRISK) IN PARIS, FRANCE

In accordance with Management Directive 3.9 and subsequent Office of the Executive Director for Operations (EDO) guidance, the information provided below concerns two presentations to be made to participants at the sixth annual meeting of the NEA/CSNI Working Group on Risk Assessment (WGRisk) in Paris, France. The presentations do not contain new or unresolved policy issues or involve broad foreign policy implication issues. This information is for your transmittal to the Commissioner Assistants.

Meeting: Sixth annual meeting of the NEA/CSNI Working Group on Risk Assessment (WGRisk)
Place: Paris, France
Dates: November 2- 4, 2005

Presentation 1
Author: A. M. Rubin
Title: Summary of Recent NRC PRA Research Activities

Presentation 2
Author: A. M. Rubin
Title: Overview of NRC PRA Activities Related to the Design of New, Advanced Reactors and Future Plants

Attachments: Presentation slides

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(RES File Code) RES _____

Overview of NRC PRA Activities Related to Design of New, Advanced Reactors and Future Plants

Alan Rubin
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission

6th WGRisk Annual Meeting
November 2-4, 2005

NRC Current Activities [redacted]

- Early Site Permits (Subpart A of Part 52) - Three utilities have applied and one additional utility has announced intention to apply for early site permits

- Pre-Application Review for Design Certification - Four designers have initiated pre-application discussions with the NRC

- Design Certification (Subpart B of Part 52) - One designer has applied for design certification, three have been approved, and one is in final rulemaking.

- Combined License (Subpart C of Part 52) - Six COL applications have been announced and others are discussing this possibility with the NRC

PRA in Advanced Reactors

- Licensing
  - Current regulations with some risk-informed components
  - Developing a proposed risk-based licensing approach
- PRA
  - Current regulations require the submittal of a PRA
  - PRA insights are being used to varying degrees by different designers
    - ESBWR is risk-informed
    - PBMR is risk-based with deterministic SSC determination

PRA in Advanced Reactors - Continued

- Heavy reliance on passive systems
  - Low driving forces posses T/H challenges
  - Margin to handle unanticipated sequences may be reduced compared to operating plant designs
  - Investigating better techniques for assessing passive system performance in PRAs
  - “Success” may be achievable at different points within a PRA, i.e., multiple top events may be appropriate for some sequences
  - T/H analyses are needed to determine the success criteria for each PRA condition or top event

PRA in Advanced Reactors - Continued

- Modeling operator interactions in PRAs
  - How should HF and HRA be modified to account for the longer response times from minutes to potentially many hours
  - Modular reactor designs propose fewer operators per module,
    - How many operators are needed?
    - External events like Loss of Offsite Power could affect all modules – how does that impact staffing?

PRA in Advanced Reactors - Continued

- Advanced reactors are to be safer
  - Leave it to industry
  - Additional requirements or regulations
  - Meet some PRA numerical goal
    - Commission's Safety Goal Policy Statement
    - CDF and LERF may not be meaningful for some advanced plant designs

PRA in Advanced Reactors - Continued

- Containment versus confinement
  - Previously licensed gas-cooled reactors had been licensed with confinements
  - Will this be applied to all advanced reactor designs?
  - How should you model confinement in PRAs?
    - Increase the containment failure split fraction to increase the failure probability
    - Double top events: one for loss of pressure retention and one for fission products retention

PRA in Advanced Reactors - Continued

- Radiological consequences in Level III PRAs
  - For some designs, LERF and early health effects may not be meaningful measures
  - Should the consequences be assessed by
    - Reactor module
    - Plant, assuming the same accident sequence in each module and summing the consequences all the modules
    - Site, including existing operating reactors

PRA in Advanced Reactors - Continued

- Determining “defense-in-depth” in PRAs for advanced reactors
  - Defense-in-depth is to compensate for human actions and component failures to maintain barrier effectiveness
  - Defense-in-depth is any *safety-related* structure, system, or component beyond what is needed for a sequence in the PRA
  - Defense-in-depth is any structure, system, or component beyond what is needed for a sequence in the PRA
  - Defense-in-depth is what is applied based on engineering judgement after the PRA is finished

PRA in Advanced Reactors - Continued

- Determining “safety-related” structures, systems, and components
  - Based on PRA-determined risk important structures, systems, and components for each sequence
  - Based on the minimum number of structures, systems, and components needed to address all analyzed accident sequences
  - Based on this minimum set of structures, systems, and components plus engineering judgement

Summary

- NRC is actively engaged in all aspects of licensing
  - Early site permits, design certification, combined license
- Many PRA modeling and PRA-related issues still need to be addressed
  - Role of PRA in plant licensing
  - Accurate modeling of passive systems (T/H and PRA)
  - Containment versus confinement
  - Defining “safer”
  - Defining/assessing defense-in-depth
  - Determining safety-related structures, systems, and components
  - Treatment of multiple reactors for a plant
    - Radiological considerations
    - Operator requirements