



Challenges in Review of Seismic/Structural Designs for New Reactors

Jim Xu, Ph. D

U.S. Nuclear Regulatory Commission
2012 NRC Regulatory Information Conference
March 13 - 15, 2012

1



Outline

- Seismic/structural regulatory framework for new reactors
- Civil/structural (C/S) design challenges and insights
- Considerations for issue resolution
- Conclusions

2



Regulatory Framework

- Part 52 process
- NRC staff guidance
- Status of application reviews
 - Completed: ABWR, AP1000, ESBWR
 - In progress: US EPR, US APWR

3



C/S Design Challenges and Insights

- Difficulties for standard plant to consider seismic design which is strongly site dependent
- C/S design attributes where clarity may be needed in SRP 3.7/3.8 guidance
- Issues with soil-structure interaction analysis methods using SASSI (System for Analysis of Soil Structure Interaction)
- Need for code based requirements for non-conventional designs

4



Challenge #1: Seismic Design for Standard Plants

- Soil characteristics are inherently site specific
- Generic profiles for standard plants can't encompass all site-specific issues
- Technical challenges
 - To what extent should design certification (DC) consider potential site profiles
 - How do we ensure generic designs are sufficiently conservative to minimize site-specific departures
 - What guidance is needed to combined license (COL) applicants to ensure adequate site-specific analyses to justify IBR (incorporate DC by reference)
 - What are scope and extent of site-specific analysis, especially Soil-structure interaction (SSI) analysis by COLs

5



Challenge #2: Clarity in Guidance on C/S Design Attributes

- Design analysis vs. evaluation analysis
- Consideration of cracking effect in seismic design of concrete structures
- II/I interactions
- Safety factors for stability evaluation
- Passive pressures
- Ground motion incoherency effect
- Criteria for permissible foundation uplift
- Foundation design to include settlement due to construction sequences and long term settlement
- Construction monitoring program to ensure the foundation conforms to the design

6



Challenge #3: Issues Associated with SSI Using SASSI

- SASSI subtraction issues
 - Subtraction method is an approximate SSI method for considering embedment effect
 - Subtraction method may produce unconservative SSI response
- Staff near term plan is to resolve SASSI issue with applicants on a case-by-case basis
- Staff is coordinating with other government agencies for long term resolution to SASSI issues (guidance, benchmarks, sharing of user experience, etc.)

7



Challenge #4: Need for Code Requirements for Non-conventional Designs

- Applications of non-conventional design to new reactors
- International operational experiences
- Needs for standardized procedures in codes and standards
- Guidance for technical review of steel-plate concrete (SC) composite construction/modular designs
- Staff works with appropriate code committees to ensure adequate requirements established
- Staff plans to develop guidance as appropriate

8



Considerations for Issue Resolution

- Development of technical basis for addressing the issues
- Early and effective communications with applicants
- Enhance guidance as needed
- Engage in inter-agency effort for SASSI resolution
- Actively engage with codes and standards communities

9



Conclusions

- Discussed technical challenges encountered during application reviews
- Outlined plans to improve guidance and thus enhance review process
- Help assure NRC processes are more efficient and effective during future reviews

10



Acronym

- COL – Combined license
- C/S – Civil Structure
- DC – Design certification
- IBR – Incorporate DC by reference
- II/I – Structural interaction of Non-Category I with Category I
- SASSI – System for analysis of soil structure interaction
- SSI – Soil structure interaction

11
