



RIC 2011 Seismic Wave Incoherency and Related Challenges

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1



Purpose

- Discuss what seismic wave incoherency is and how it has been applied in new reactor licensing
- Discuss technical and regulatory challenges associated with seismic wave incoherency
- Communicate path forward

2



Presentation Outline

- Regulatory Basis
- What is INCOHERENCY?
- Application of Incoherency
- Regulatory Guidance
- Technical & Regulatory Challenges
- Path Forward
- Conclusions

3



Regulatory Basis

- GDC 2, Appendix A to 10 CFR Part 50, "Design Bases for Protection Against Natural Phenomena"
- Appendix S to 10 CFR Part 50, "Earthquake Engineering Criteria for Nuclear Power Plants"
- 10 CFR Part 100, Section 23, "Geologic and Seismic Siting Criteria"

4



What is INCOHERENCY?

- Safety-related structures must be designed taking into account the effects of soil-structure interaction (SSI) due to seismic wave motion
- Seismic wave motion is not identical at all points on the foundation but it varies point to point
- Seismic wave incoherency (or incoherence) is a phenomenon associated with the "spatial variation" of earthquake-induced ground motion on a horizontal plane
- Sources of incoherency:
 - Local wave scattering
 - Wave passage effects

5



Application of Incoherency

- Effect of high-frequency (HF) ground motion on the seismic design of new reactors at CEUS hard-rock sites is a key technical issue
- Use of incoherency could potentially reduce seismic demands for safety-related structures subjected to HF ground motion
- Applicants have used incoherency to address site-specific HF ground motion exceedance of the standard design ground motion for new reactors (COL GMRS > DC CSDRS)

6



Guidance on Incoherency

- SRP/NUREG-0800 (2007) Section 3.7.1, “Seismic Design Parameters”
 - Provides high-level guidance on incoherency
- DC/COL-ISG-1 (2008), “Seismic Issues Associated with High Frequency Ground Motion in DC and COLs”
 - Provides guidance on
 - Computer codes for incoherency analysis
 - Coherency functions
 - Requirements for structural models
 - HF sensitive mechanical and electrical equipment/ components, etc.

7



Technical & Regulatory Challenges

- Incoherency-based SSI analysis methodology is complex and still evolving
- Limited expertise and experience in incoherency based seismic SSI analysis – a new approach applied to new reactor design
- Scope and level of detail of technical information provided by the applicant for staff review is evolving
- Incoherency-based SSI analysis results are sensitive to the design and site conditions. Validity of results must be evaluated on a case-by-case basis
- Regulatory guidance on incoherency needs to reflect evolving state of the art, industry experience, and lessons learned from staff review

8



Path Forward

- Maintain knowledge of the state of the art
- Promote communication of staff expectations and industry experience
- Develop a focused team approach for licensing reviews across design centers dealing with incoherency
- Update and expand regulatory guidance on incoherency as necessary incorporating stakeholder’s feedback and lessons learned from staff review

9



Conclusions

- SSI analysis based on incoherent seismic wave motion is a new approach to the licensing of new reactors at CEUS hard-rock sites
- Incoherency has been used to address HF ground motion exceedance at new reactor sites, with the adequacy of results evaluated on a case-by-case basis
- Thus far, applications with incoherency-based seismic SSI analysis have been found acceptable
- Application of the complex incoherency-based methodology requires specialized technical knowledge and expertise of applicants and staff
- Regulatory guidance on incoherency should be updated as necessary to reflect the industry experience and lessons learned from staff review

10



Acronyms

- CEUS – Central and Eastern United States
- COL – Combined License
- CSDRS – Certified Seismic Design Response Spectra
- DC – Design Certification
- GMRS – Ground Motion Response Spectra
- HF – High Frequency
- ISG – Interim Staff Guidance
- SRP – Standard Review Plan
- SSI – Soil Structure Interaction

11
