Regulatory Information Conference 2012

Challenges and Lessons Learned
In Design and Analysis of
Civil Structures for New Reactors

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In the beginning…

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Chapter 2 Issues

- Subsurface soil characterization
  - RCTS testing (new technology)
  - Limited testing facilities
  - Shear wave velocity departure
- Site-specific GMRS
  - Probabilistic Seismic Hazards Analysis (new technology)
  - Limited industry expertise
  - EPRI CEUS report (new input requirements)

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Chapter 2 Issues

- RG 1.221 hurricane wind/missiles
  (11th hour impact on structural analysis)
- Ground water elevation
- Design basis flood

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Magnitude of 3.7/3.8 Effort

- ~4 years (COLA Rev. 2 submitted Sept 2008)
- DCD 3.7/3.8 – 160 pages
- COLA 3.7/3.8 – 26 pages
- 209 RAI's
- 130 COLA changes
- 55 letters
- 4,262 pages of RAI submittals
- 5 NRC Audits
- 5 Public Meetings
- 1 Inspection
- 135,000 Engineering Man-Hours

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SASSI Complicating Issues

- Input parameters - Poisson's ratio, mesh size, soil parameters (in-situ & backfill), ground water elevation
- SASSI Part 21 (unique to ACS SASSI)
- DOE SASSI Issue (Validity of Subtraction Method)
- Software Verification and Validation (V&V)

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Observations – Design Margin

- Differing NRC and NINA interpretations lead to consideration of higher loads than originally contemplated by NINA
  - Designers should increase design margins beyond minimum requirements and quantify available margins
  - "Banked" margin will be used to address unforeseen load increases during regulatory review

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Observations – Engineering Judgment

- "Engineering Judgment" will not be adequate to resolve technical issues
  - Additional analyses will be required to quantify available margins considering different perspectives or interpretations
  - What may seem obvious to the designer must be demonstrated to support regulatory conclusions

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Observations – Analytical Tools

- State-of-the-Art analytical methods give rise to subtle differences in expert opinions
  - Seemingly obscure issues may require substantial analysis to determine the sensitivity of results to inputs and assumptions
  - Accepted practice may vary depending on the experience of particular experts
  - Analytical limits of computer models are not always well understood

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Results

- Years of reanalysis
- Design of structures has not changed
  - Design margins have been reduced
- In-Structure response spectra have increased in some locations

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Recommendations for Future COLAs

- Start early
- Develop a comprehensive plan for structural analysis
  - Selection of computer codes
  - Inputs and assumptions
  - Verification and validation
- Document Margins
- Obtain NRC feedback on plan before work
  - May be difficult prior to COLA submittal
- Meet regularly to review results

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Acronyms

- CEUS – Central and Eastern United States
- GMRS – Ground Motion Response Spectra
- RAI – Request for Additional Information
- RCTS – Resonant Column / Torsional Shear
- SASSI – System for Analysis of Soil-Structure Interaction

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