New Plant Seismic Issues
Update to IEEE SC2

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New Plant Seismic Issues

- Background
- Existing Plants
- New Plant Issues
- Example Analysis
- High Frequency Sensitive Items
Seismic Ground Motions

RG 1.60 Response Spectrum

RG 1.60 Spectrum

Seismic Ground Motions

New Plant
Seismic

Typical CEUS Uniform Hazard Spectrum

RG 1.60 Response Spectrum
EPRI Hazard Studies
LLNL Hazard Studies

0.1 1.0 10.0 100.0

Acceleration
Frequency

Seismic Ground Motions

UrD Response Spectrum

Utilities Requirement Document

New Plant Seismic
Seismic Ground Motions

RG 1.165 Estimated Response Spectrum

RG 1.165 Seismic Sources and SSE

EPRI Hazard Studies RG 1.165

Seismic Sources and SSE Requirement

LLNL Hazard Studies

Response Spectrum RG 1.60

0.1 1.0 10.0 100.0 Acceleration

0.1 1.0 10.0 100.0 Frequency

Seismic Ground Motions

Example ESP Response Spectrum

Acceleration vs. Frequency


RG 1.165
Seismic Sources and SSE

Utility ESP and COLA

New Plant Seismic
Individual Plant Examination of External Events (IPEEE) For Severe Accident Vulnerabilities – GL 88-20, Supplement 4

  - Acknowledged the new hazard estimates and “... relatively higher ground motions at frequencies greater than 10 Hz...”
  - No plant specific response necessary for high frequency motion provided special margin evaluations were performed for non-ductile components such as relays
Evaluations for Existing Plants

- NUREG-1407 Relay Evaluations
  - Attempts to address by analysis likely to entail extensive efforts
  - More suitable approach
    - Determine relays with high frequency sensitivity (SQUG low ruggedness relay list)
    - Screen relays with high seismic capacities (HCLPF)
    - Screen relays using circuit analyses or operator actions
    - Replace or retest remaining relays
Evaluations for Existing Plants

- USI A-46 Resolution
  - SQUG developed a low ruggedness (bad actor) relay list based on test and operating experience
  - Performed detailed relay reviews
  - Coordinated walkthroughs and evaluations with IPEEEE reviews
GI 199 - Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States

- Initiated in May 2005
- RG 1.165 specifies a reference probability for exceedance of a safe shutdown earthquake ground motion based on 29 CEUS sites
- Preliminary results from a 2004 USGS report indicated that the reference probability has increased
- Contractor work has been delayed pending reviews of EPRI information
Seismic Issue - New Plants

Recent CEUS seismic hazard studies CEUS
- Primary increase in high frequency portion of hazard at rock sites
- Unstable regulatory process
- RG 1.165 uses a reference probability
- New seismic data or changes in previous data changes the target earthquake for everyone
- ESPs demonstrated high site spectra
- Clinton, North Anna
- COL work showing similar results
- Bellefonte, Lee, Summer, Shearon Harris

Example ESP Response Spectrum
NEI/EPRI Seismic Issues Program

New Plant Seismic

RG 1.208

Lower Bound Magnitude Distribution CAV-Based

Standard Deviation for Ground Motion Models in CEUS

Probabilistic Seismic Hazard Assessment

Performance Goal-Based Method (Similar to ASCE 43-05)

Applicability of Performance Goal-Based Method

Site-Specific SSE Response Spectrum

High Frequency Reduction via Incoherence

Site-Specific Design Response Spectrum

High Frequency Reduction via Inelastic Behavior (On Hold)

High Frequency Screening Test (Contingency)
Example Analysis

Reduced spectra using hazard improvements and alternate performance-based process

Incoherence reductions require ISRS analysis
Example Analysis

New Plant  
Seismic

![Graph showing acceleration vs frequency for different analyses including Certified Design Analysis, ISRS w/o Incoherence, and ISRS w/ Incoherence.](image)
Example Analysis

New Plant
Seismic

FRS Comparison Y Direction

- Certified Design Analysis
- ISRS w/o Incoherence
- ISRS w/ Incoherence

Acceleration (g)
Frequency (Hz)
Example Analysis

New Plant
Seismic
High Frequency Resolution

- Use new methods to reduce high frequency motions as much as possible
  - Hazard improvements and alternate Performance-based method
  - Incoherence reductions

- Qualitative evaluation for structural items
  - White Paper EPRI Report
  - Limited stress comparisons
High Frequency Resolution

- Screening for potentially high frequency sensitive items
  - Selection criteria for items
  - Determination of high frequency requirement
  - Evaluation methods