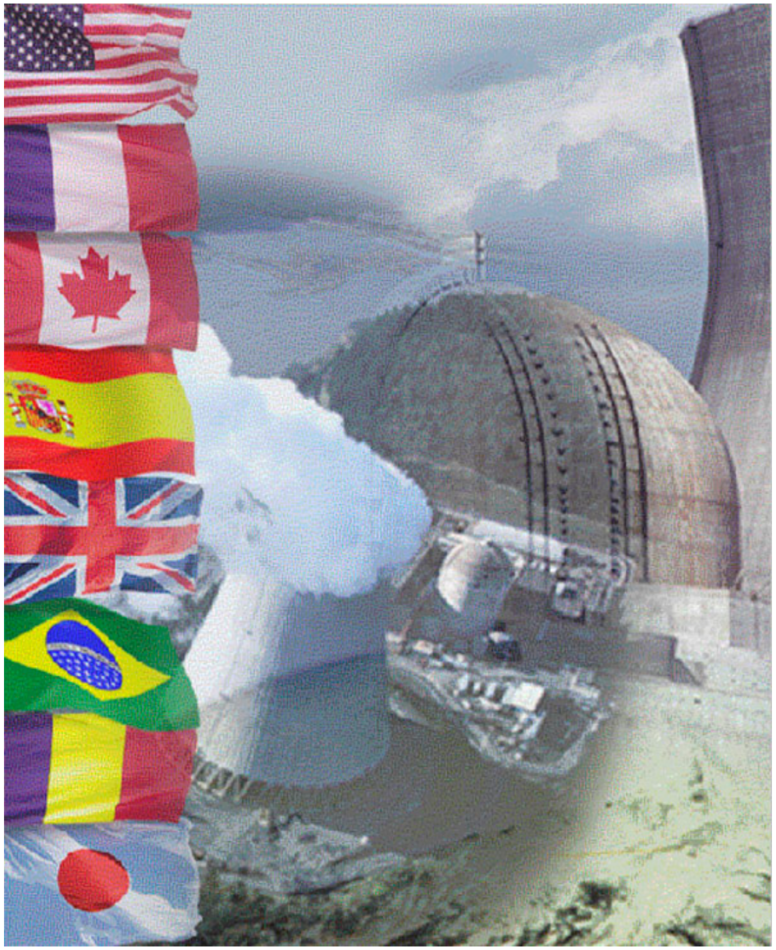

ELECTRIC POWER RESEARCH INSTITUTE

New Plant Seismic Issues Resolution Program

Task G1.2 – Lower Bound Magnitude Characterization

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Task G1.2 – Motivation and Scope

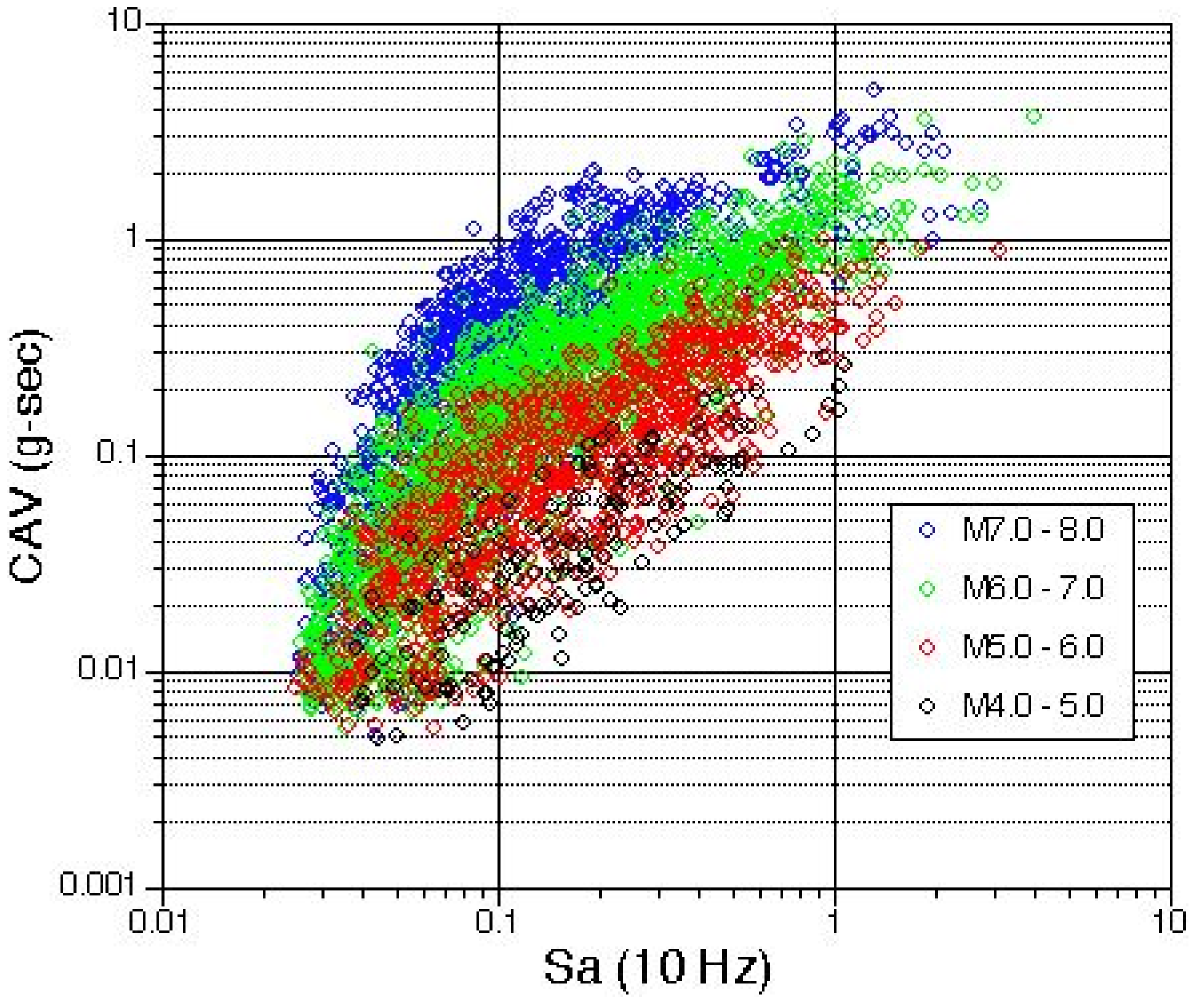
Lower Bound Magnitude Characterization

- Choice of lower bound magnitude (LBM) has major impact on computed hazard levels, especially for higher frequencies
- A realistic LBM distribution would reduce hazard consistent with realistic damage potential of small earthquakes
- Task is studying
  - Large database of Earthquakes
    - Western (Large Number Available) and Eastern Earthquakes Studied
    - Correlation between Magnitude and CAV Being Analyzed
    - Established Conservative CAV of 0.16g-sec Utilized to Represent Non-Damaging Earthquakes to Engineered SSCs (EPRI NP-5930)
  - Cumulative Absolute Velocity (CAV) to provide the basis for the LBM distribution

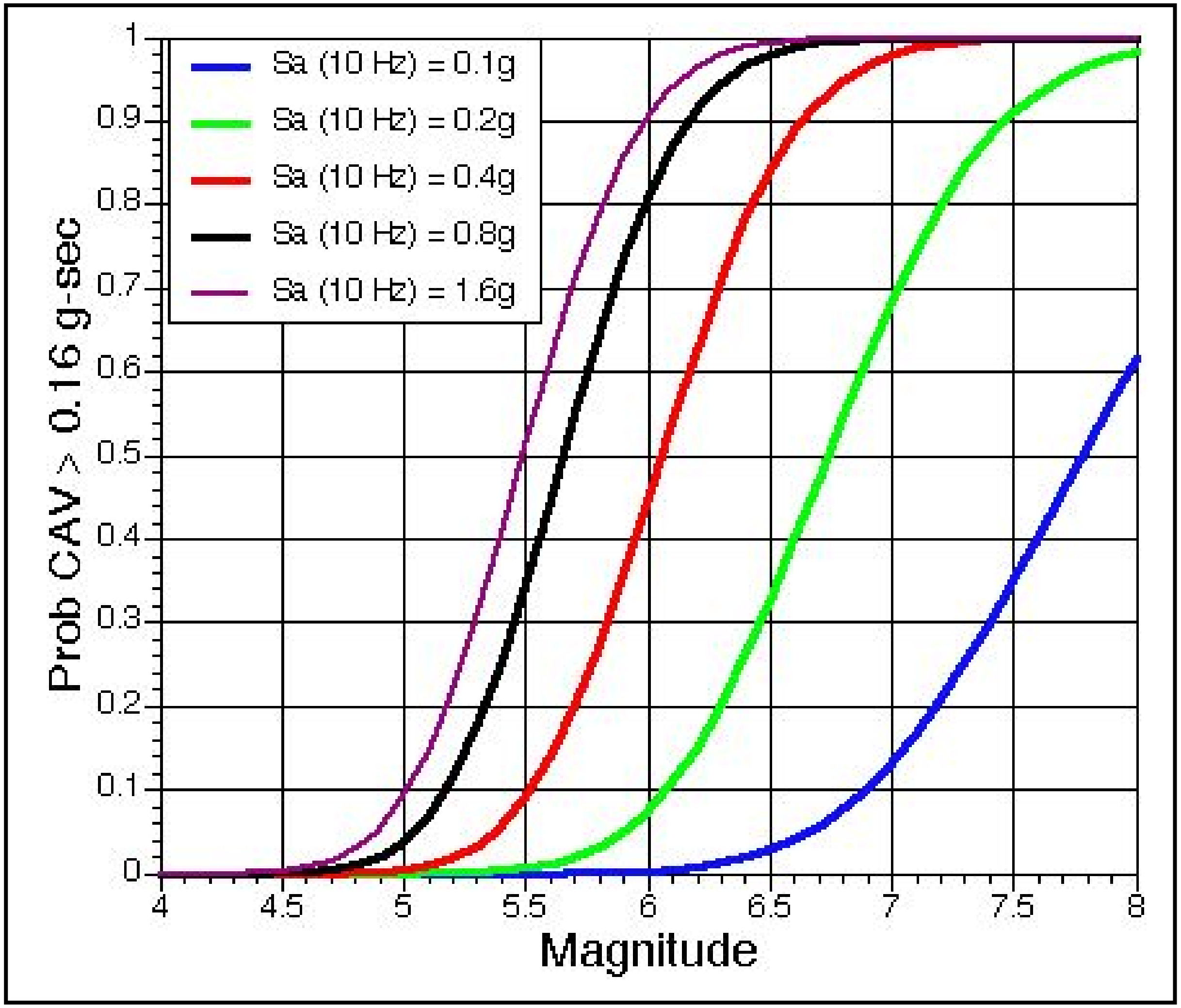
CAV Approach for G1.2

- Task 1 - Initial Trial Application
  - Compute the 10 Hz and 20 Hz hazard curves for CEUS rock site using the USGS source model and the Toro et al (1997) attenuation relation
  - Re-compute the hazard using an existing CAV model based on WUS. This model gives Probability (CAV>0.16g-sec)
    - Initial WUS CAV model depends on M, Sa, Vs30
    - All parameters available from PSHA results
  - Assess the impact of this approach

CAV from WUS Data



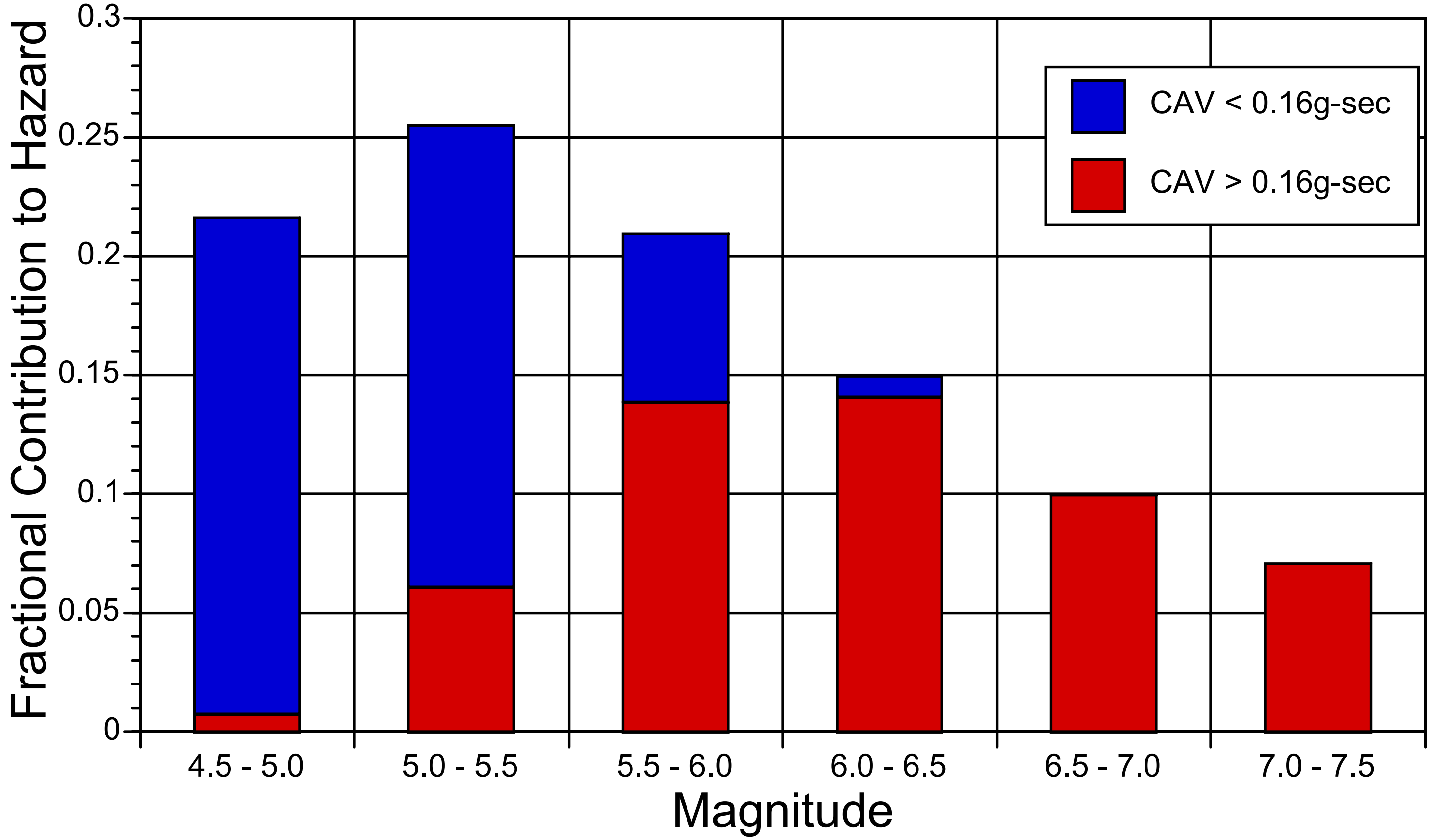
Probability of CAV Exceeding 0.16-g sec based on WUS Data



Application of CAV Filtering

- Given Rock Site Hazard
  - Hazard curve
  - Deaggregation
- Break hazard down into contribution from scenario events
  - Haz(z) * Deagg(M,R,z)
- Compute Rates of occurrence
  - M, R, z
- Remove events with CAV < 0.16g-s
- Re-Sum rates of events to get CAV filtered hazard curve

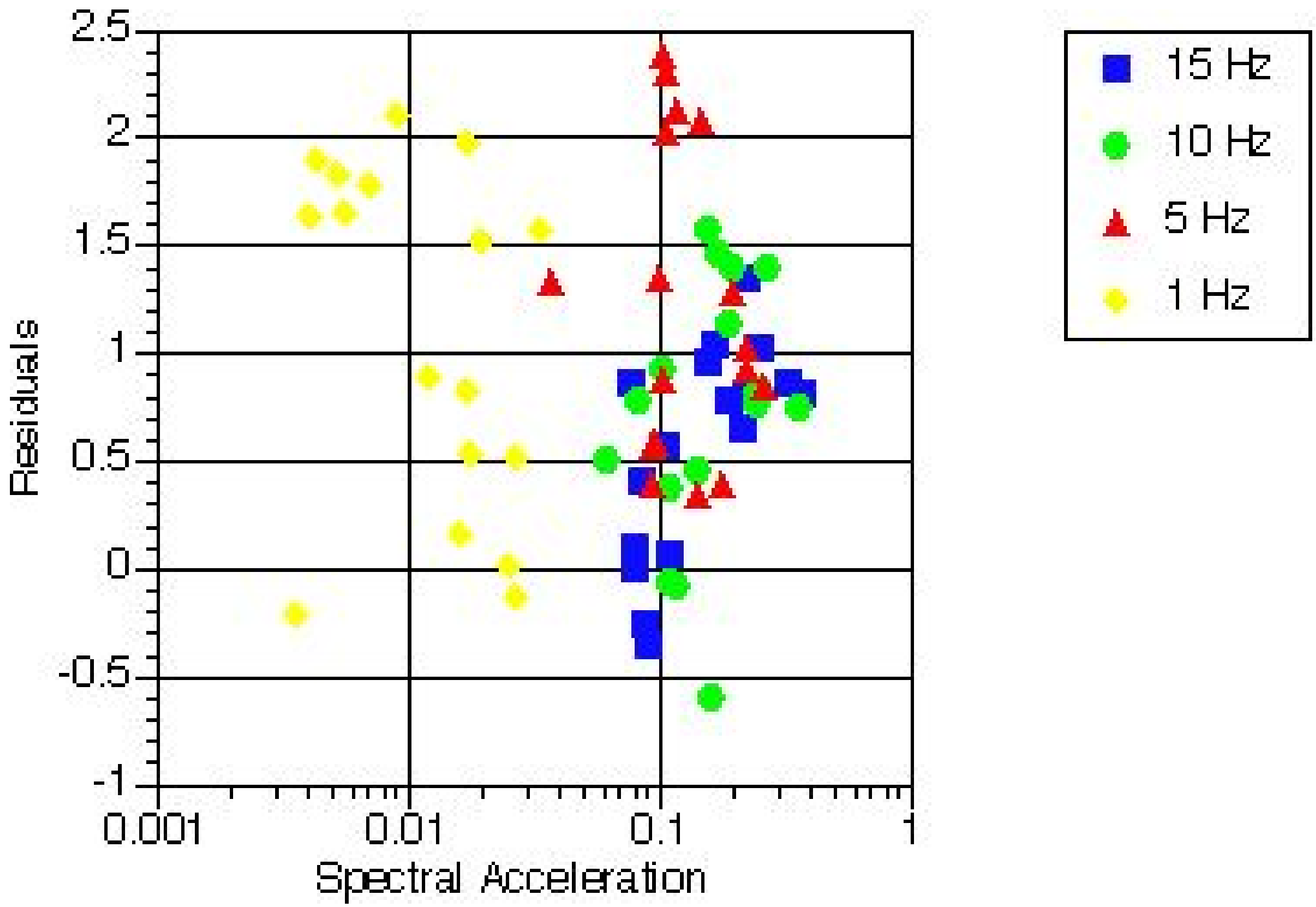
Contribution by Magnitude using WUS CAV model: Sa(10 Hz) >= 0.6g, M>4.6



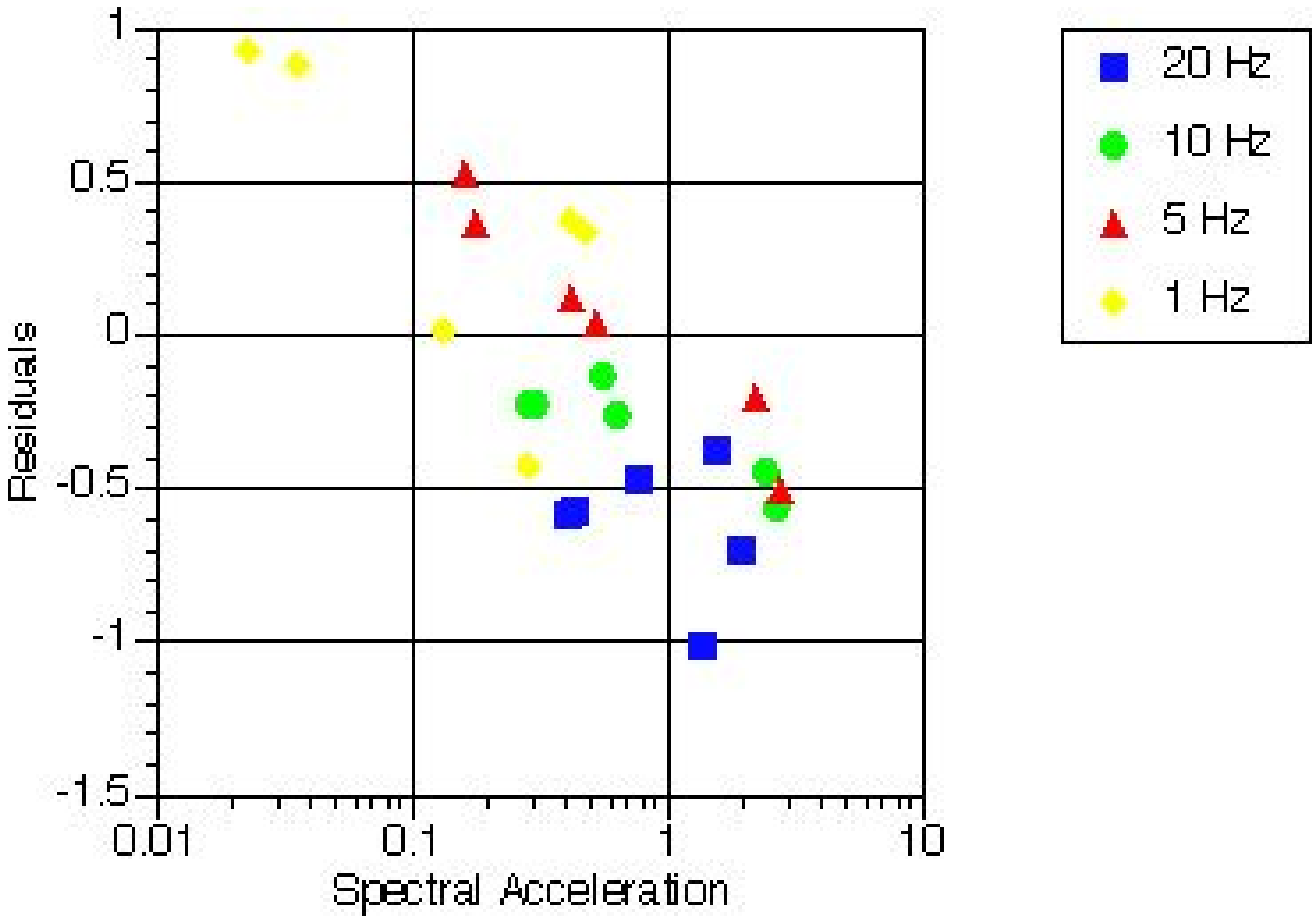
CAV Approach for G1.2

- Task 2 - Compare initial WUS CAV models with empirical CAV data from EUS earthquakes
  - Small number of strong motion recordings from EUS
  - Collect available EUS data
  - Calculate CAV values from this EUS data
  - Compare to the predicted CAV values from the WUS model as a check on the model
    - Significant underestimation of CAV for Saguenay
    - Need to revise CAV model

CAV Residuals for Saguenay using Initial WUS CAV Model



CAV Residuals for Nahanni using Initial WUS CAV Model



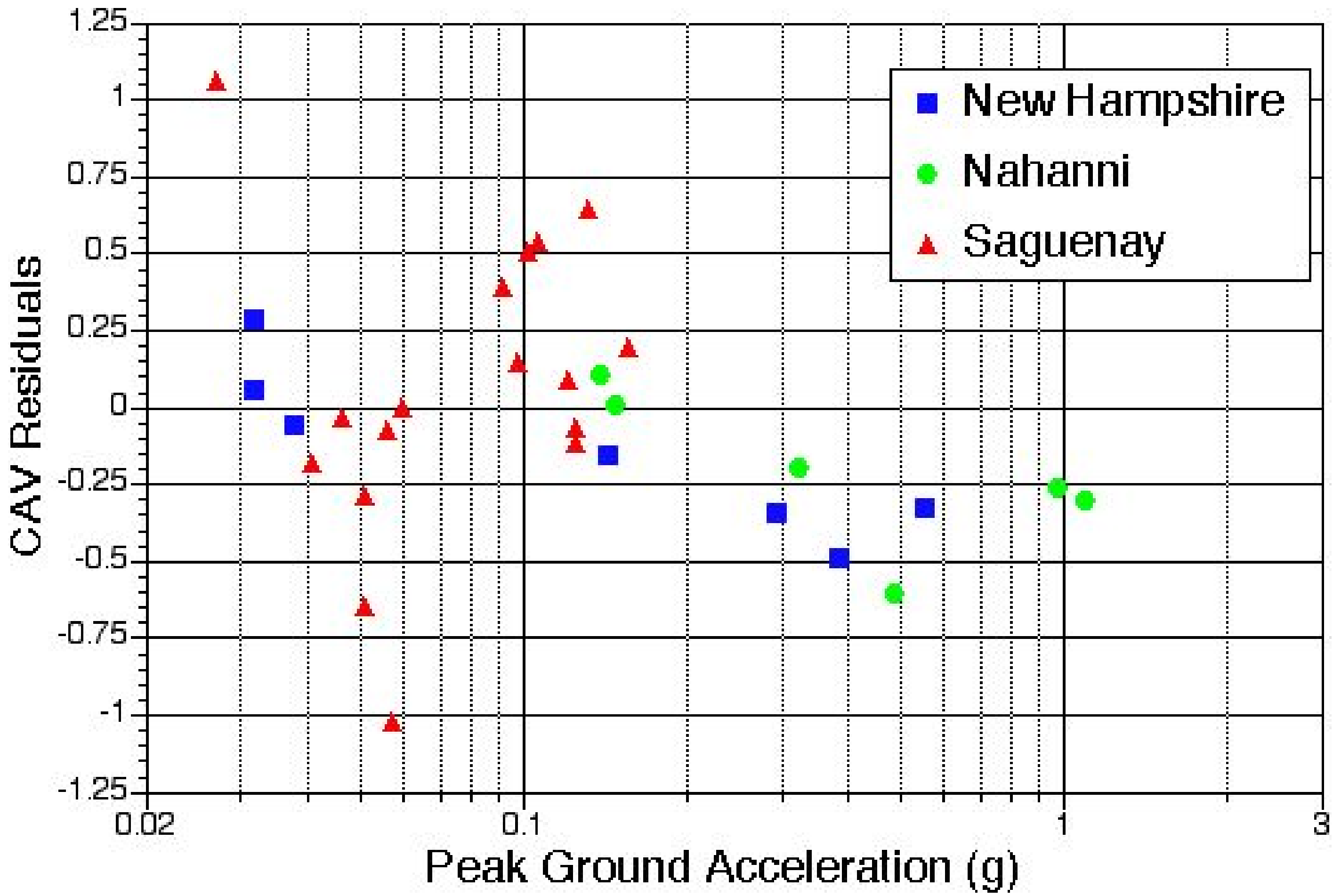
CAV Approach for G1.2

- Task 3 - Develop new CAV model model that accounts for differences between the WUS and EUS ground motions
  - CAV strongly dependent by duration
  - Develop new CAV models including duration
    - CAV depends on M, PGA, Vs30, and Uniform duration
  - Use seismological models of the duration for the WUS and EUS to account for differences in EUS and WUS
    - Uniform duration not available from standard PSHA results
    - Use expected duration from seismological models to estimate Uniform duration
    - Resulting CAV model depends on M, R, PGA, Vs30
      - All parameters available from PSHA
  - Check new CAV model using EUS data

CAV Approach for G1.2

- Task 4 - Trial Application
  - Use the EUS Probability (CAV>0.16g-sec) model
  - Compute UHS spectra for Example EUS Site
- Task 5 - Documentation
  - EPRI Report documenting results of task
- Potential Phase 2
  - Create new UHS spectra for 28 CEUS Sites

CAV Residuals using Revised EUS Model

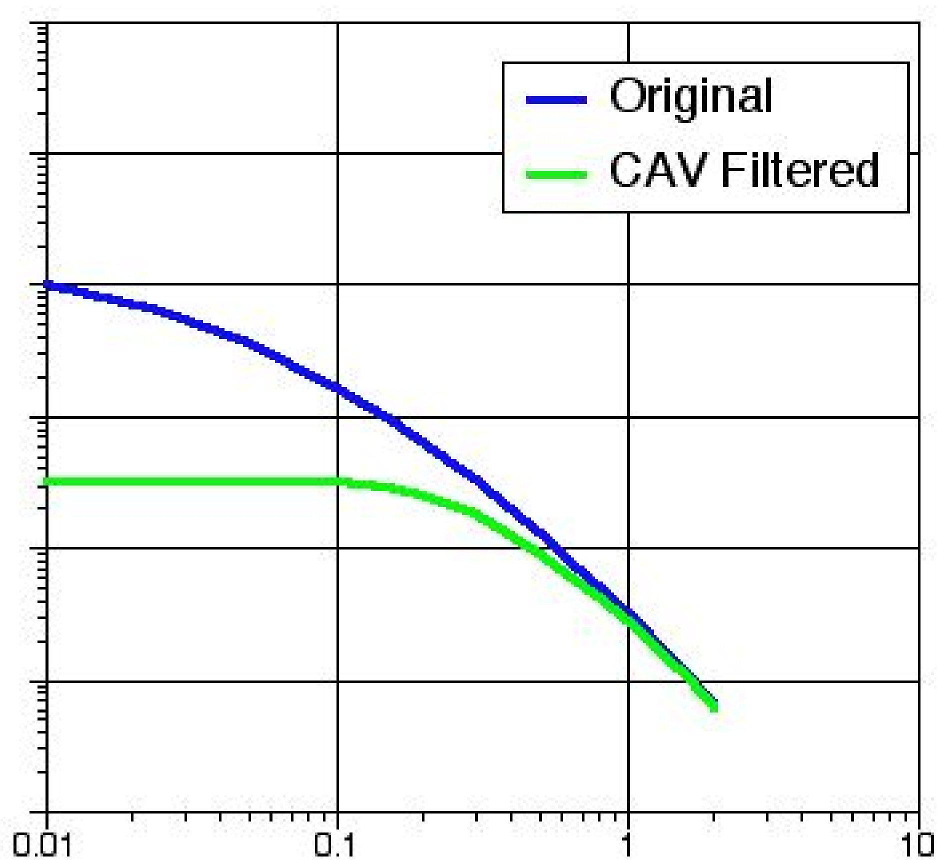


Trial Application using the EUS CAV model: 10 Hz

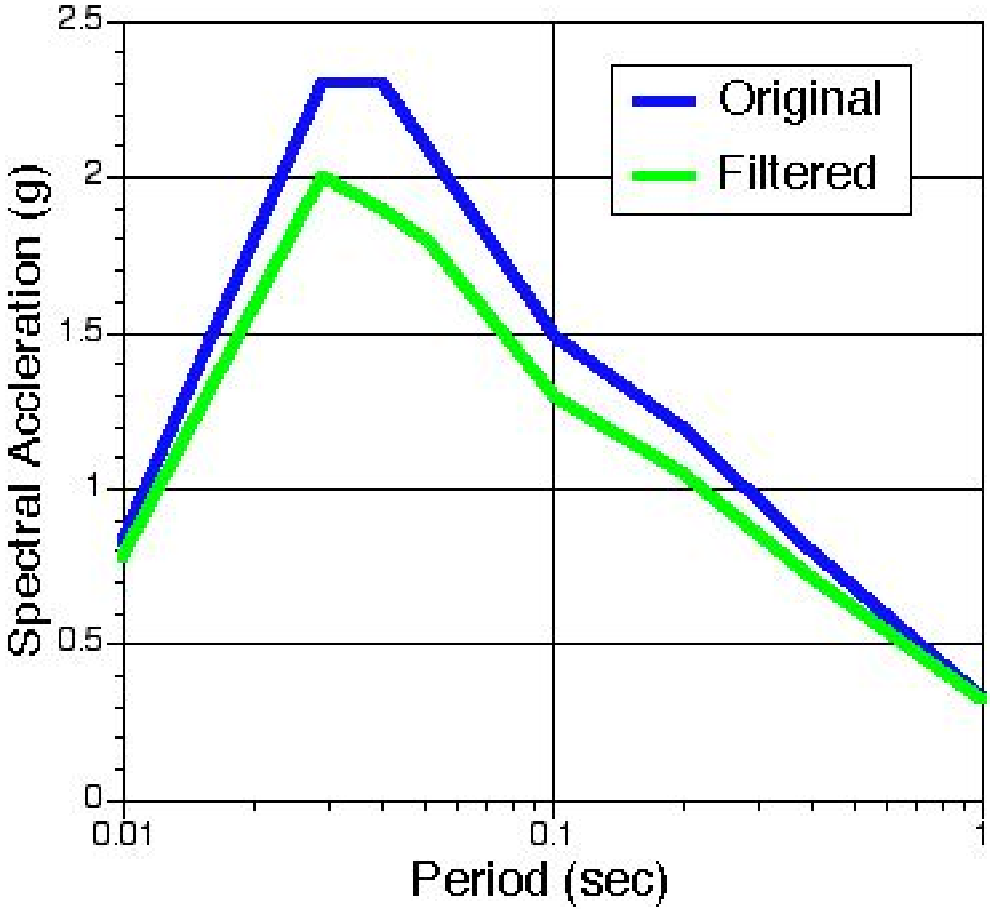
USGS (2002) Smoothed seismicity

Toro et al (1997) Attenuation

EUS CAV model



Trial Application: Uniform Hazard Spectra



USGS (2002) Smoothed seismicity

Toro et al (1997) Attenuation

EUS CAV model

Effects of Using Minimum CAV from Trial Application

- Hazard curves flatten at some annual probability level
  - Ground motion is zero for smaller probabilities (above the flat part of the hazard curve)
  - A minimum ground motion level will need to be defined
- Reduction of high frequency UHS
  - 15-30% reduction in peak of spectrum depending on probability level
  - Greater reduction for higher probability levels
- Controlling earthquake (from deaggregation) for high frequencies will change for sites away from New Madrid and Charleston
  - Magnitude 6 earthquakes will control rather than magnitude 5 earthquakes