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B&W mPower™ Reactor Seismic Update and Hydrology Discussions

17 May, 2012

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Seismic Update and Hydrology Discussions

- Plant Layout
- Recap of May 2011 Seismic Meeting
---Break
- EPRI CEUS Seismic Source Report
- SSI Analysis Using SASSI
---Lunch
- SSI Modeling Studies
- Nuclear Island SSI Model
- Structural Analysis and Design Plan
- Considerations for Groundwater and Probable Maximum Flood
- Recap

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Plant Layout

Martin Reifschneider

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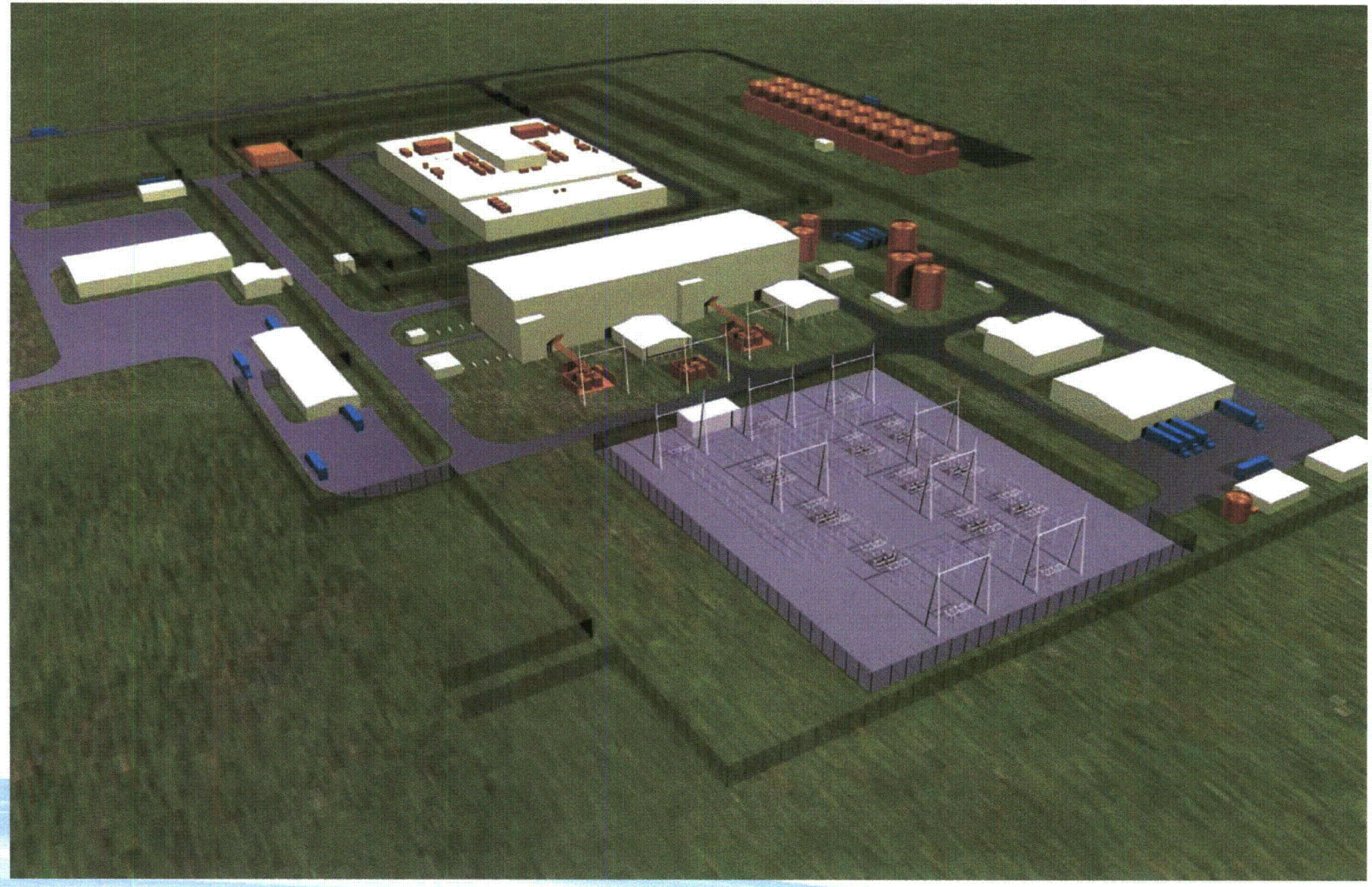
Site Overview Looking South



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Plot Plan

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[CCI per Affidavit 4(a)-(d)]

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Model Cut Looking West

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[CCI per Affidavit 4(a)-(d)]

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RCB Looking West

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[CCI per Affidavit 4(a)-(d)]

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RCB Looking North

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[CCI per Affidavit 4(a)-(d)]

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RCB Plan El. [ ]

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RCB Plan El. [ ]

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RCB Plan El. [ ]

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RCB Plan El. [ ]

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RCB Plan El. [ ]

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Nuclear Island (RSB) Looking West

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[CCI per Affidavit 4(a)-(d)]

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Nuclear Island (RSB) Looking North

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[CCI per Affidavit 4(a)-(d)]

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Nuclear Island (RSB) Plan El. [ ]

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[CCI per Affidavit 4(a)-(d)]

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Nuclear Island (RSB) Plan El. [ ]

[CCI per Affidavit 4(a)-(d)]

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[CCI per Affidavit 4(a)-(d)]

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Nuclear Island (RSB) Plan El. [ ]

[CCI per Affidavit 4(a)-(d)]

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[CCI per Affidavit 4(a)-(d)]

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Nuclear Island (RSB-Annex) Plan El. [ ]

[CCI per Affidavit 4(a)-(d)]

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[CCI per Affidavit 4(a)-(d)]

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Nuclear Island (RSB) Plan El. [ ]

[CCI per Affidavit 4(a)-(d)]

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[CCI per Affidavit 4(a)-(d)]

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Nuclear Island (RSB-Annex) Plan El. [ ]

[CCI per Affidavit 4(a)-(d)]

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Nuclear Island (RSB) Plan El. [ ]

[CCI per Affidavit 4(a)-(d)]

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[CCI per Affidavit 4(a)-(d)]

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Nuclear Island (RSB) Plan El. [ ]

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[CCI per Affidavit 4(a)-(d)]

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Nuclear Island (RSB-Annex) Plan El. [ ]

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Nuclear Island (Radwaste) Plan El. [ ]

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Recap of May 2011 Seismic Meeting

Mike McHood

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Recap of May 2011 Seismic Meeting

- Soil Profiles for Generation mPower (GmP) standard plant
- Development of Certified Seismic Design Response Spectra (CSDRS) for GmP
  - FIRS from other DCDs and COL Applications
  - Ground Response
- USGS PSHA
- Eastern Tennessee
- V/H

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Soil Profile Selection Strategy

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CSDRS Evaluation

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CSDRS Selection

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WUS CSDRS Input

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CEUS CSDRS Input

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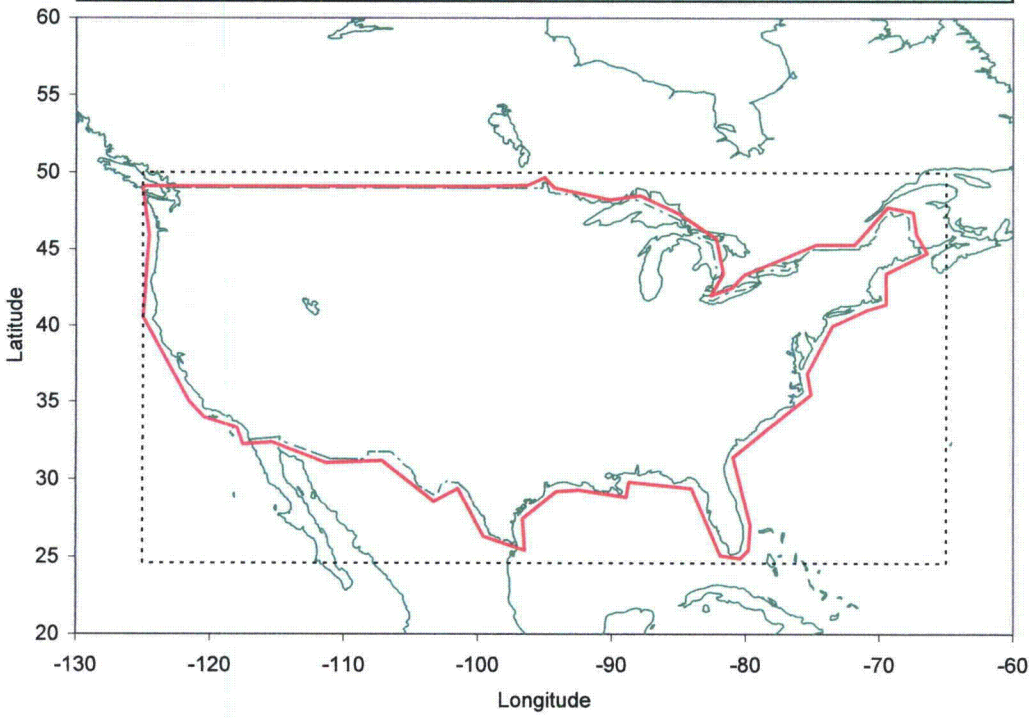
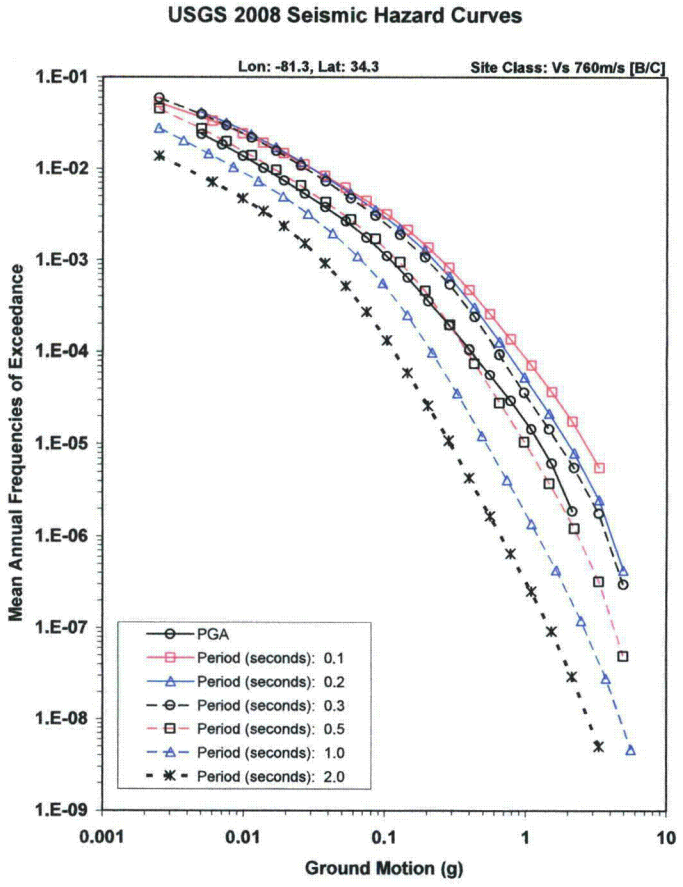
USGS 2008 Seismic Hazard Data

http://earthquake.usgs.gov/hazards/products/conterminous/2008/data/





- Originally, **611,309** grid locations spaced at 0.05°, filtered to **362,509** land-only values
- Originally, NEHRP Site Class B/C seismic hazard curves
- Use amplification factors from Petersen et al. (2008) to convert to hard rock ["Site Class A"] hazard curves
- PGA and 6 response spectral periods: 0.1, 0.2, 0.3, 0.5, 1.0, and 2.0 seconds

USGS 2008 Seismic Hazard Data

Regulatory Guide 1.208: Definition of the GMRS/FIRS

The site-specific PSHA seismic hazard curve slope factor $A_R(f)$ is determined from:

$$A_R(f) = Sa(f \mid 10^{-5}) / Sa(f \mid 10^{-4}) \quad \text{Eq. 1}$$

where *f* is frequency and $Sa(f \mid 10^{-4})$ and $Sa(f \mid 10^{-5})$ are response spectral acceleration values for the hazard levels of 10^{-4} and 10^{-5}, respectively.

The "Design Factor" DF(f), based on A_R, is given by:

$$DF(f) = \textit{maximum}\ \{\ 1.0,\ 0.6 \times A_R(f)^{0.80}\ \} \quad \text{Eq. 2}$$

Finally, design response spectrum DRS(f) is given by:

$$\begin{aligned} DRS(f) &= Sa(f \mid 10^{-4}) \times DF(f) && \text{for } A_R(f) \leq 4.2 \\ &= 0.45 \times Sa(f \mid 10^{-5}) && \text{for } A_R(f) > 4.2 \end{aligned} \quad \text{Eq. 3}$$

where the design response spectrum [DRS(f)] is, depending on subsurface horizon and design intent, the GMRS or Foundation Input Response Spectra (FIRS).

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USGS 2008 Seismic Hazard Data
(Reflects Bechtel Calculations)

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CSDRS vs Eastern Tennessee

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Design Spectra for Eastern Tennessee

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[CCI per Affidavit 4(a)-(d)]

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[CCI per Affidavit 4(a)-(d)]

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Recommended V/H

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CEUS Recommended V/H

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[CCI per Affidavit 4(a)-(d)]

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WUS Recommended V/H

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Recommended V/H

- V/H ratios from NRC guidance are typically applied to surface or near surface spectra

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CEUS Seismic Input Motion

- For each design spectrum GmP has fit a 3-component set of time histories as allowed by current NRC guidance

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EPRI CEUS Seismic Source Report

Joe Litehiser

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PSHA Studies Other than USGS (2008)

Composite EPRI-USGS Hybrid (60 CEUS NPP sites)

- USGS (2008) source model
  - (Geographic distribution of recurrence, Mmax distribution.)
- EPRI (2004, 2006) ground motion prediction equations
  - (SA (M, D), aleatory and epistemic uncertainty, CAV.)
- EPRI (2005, 2008) site-specific amplification factors
  - (Based on subsurface profiles for NRC licensing documents.)
  - (Used to develop five general site conditions.)

EPRI CEUS-SSC Follow-up (60 CEUS NPP sites)

- Site-specific amplification factors at several elevations
  - (For UHS and FIRS)
- Additional PSHA using interim NGA-East GMPEs?

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EPRI Study Demonstration Sites

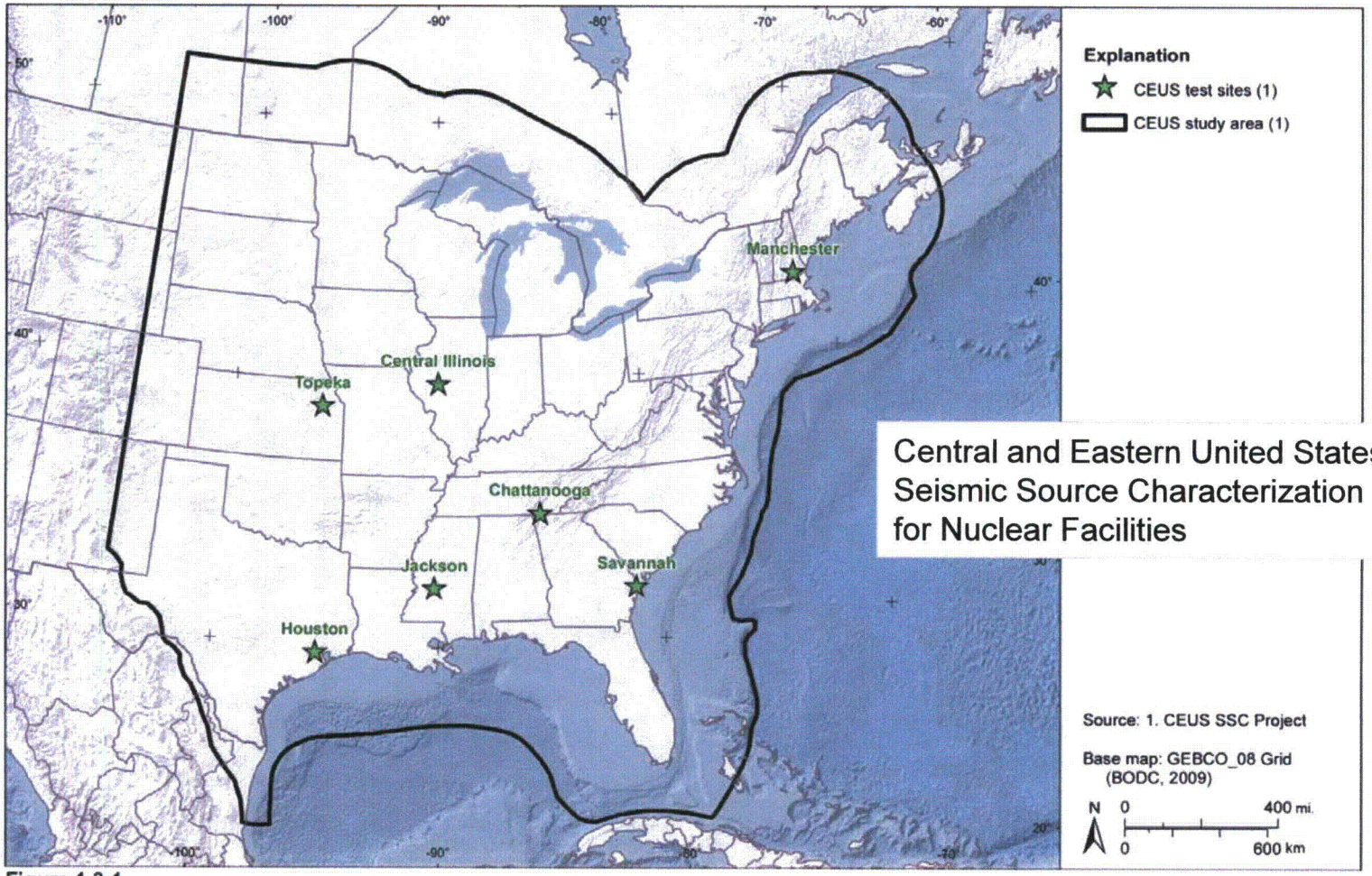

Figure 1.3-1
Map showing the study area and test sites for the CEUS SSC Project

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USGS Seismic Hazard
(Reflects Bechtel Calculation)

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EPRI Rock Hazard Curves

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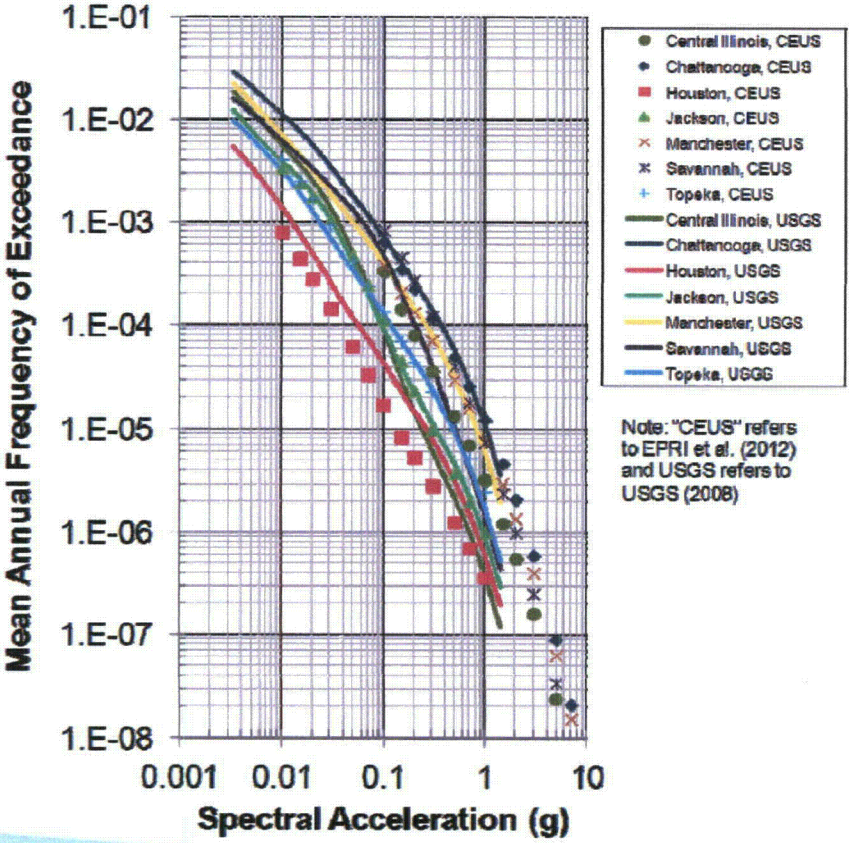
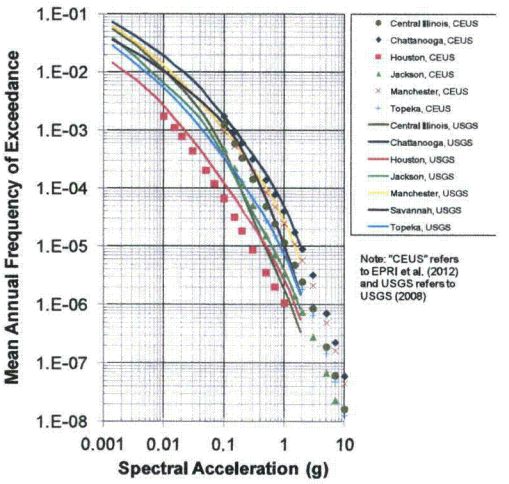
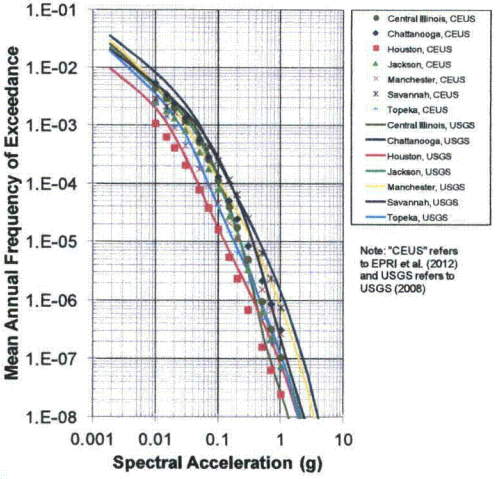
PGA Rock Hazard Curves



10 Hz Rock Hazard Curves



1 Hz Rock Hazard Curves



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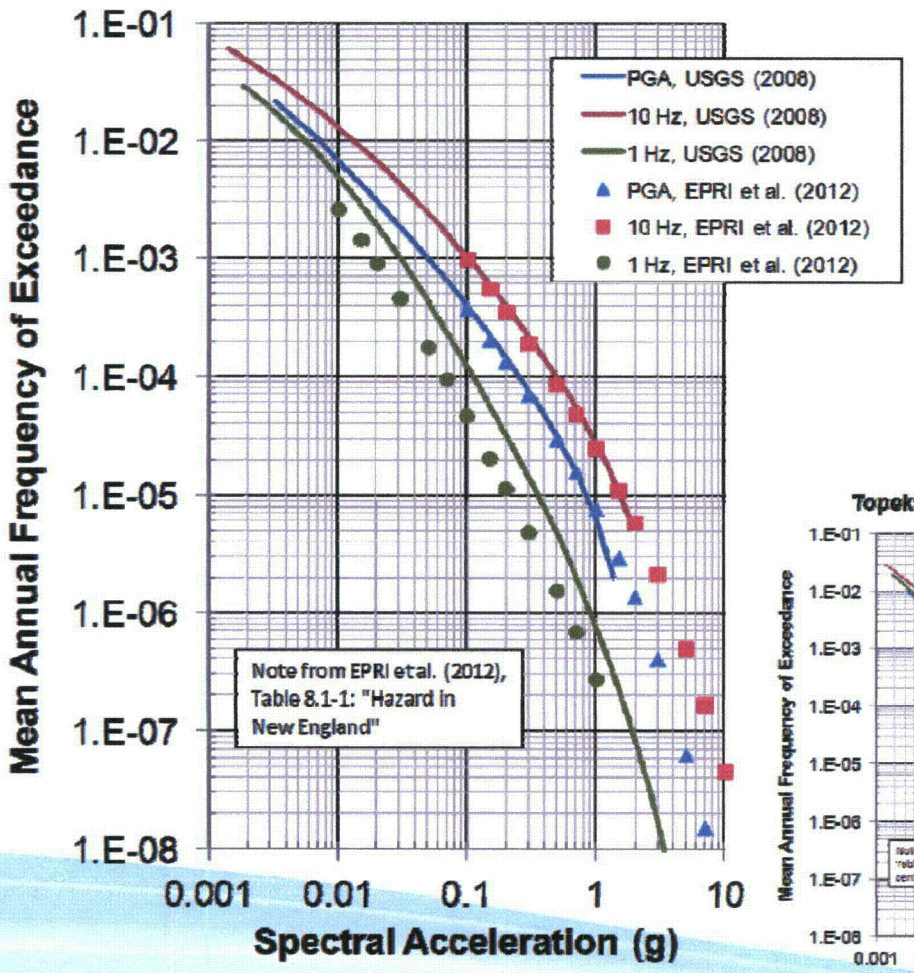
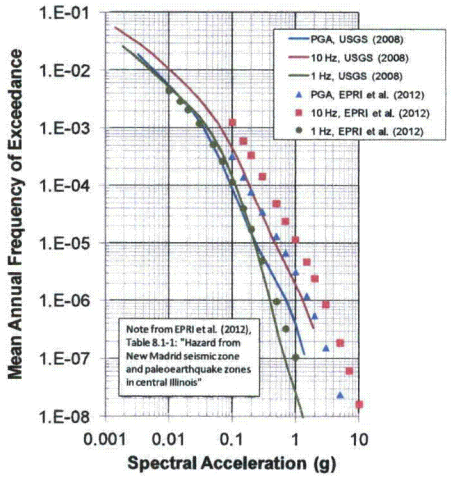
EPRI Rock Hazard Curves

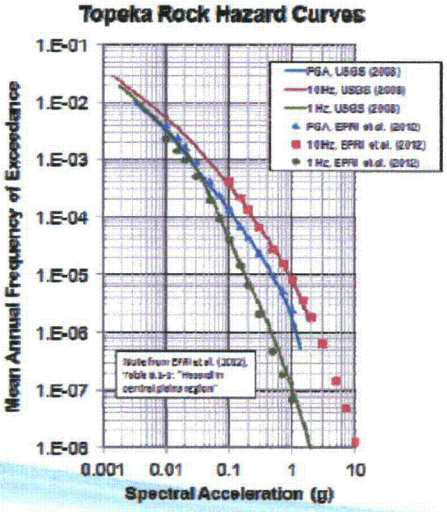
Manchester Rock Hazard Curves



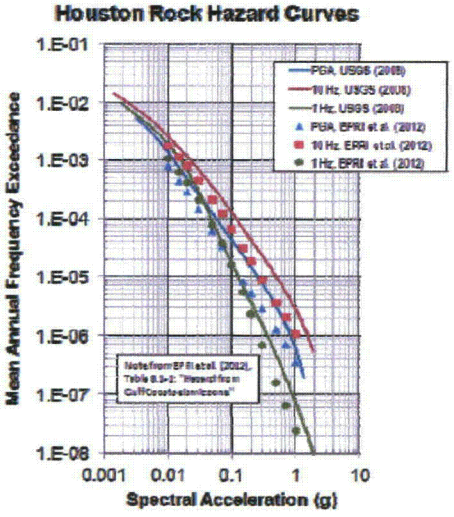
Central Illinois Rock Hazard Curves



Topeka Rock Hazard Curves



Houston Rock Hazard Curves



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EPRI Rock Hazard Curves

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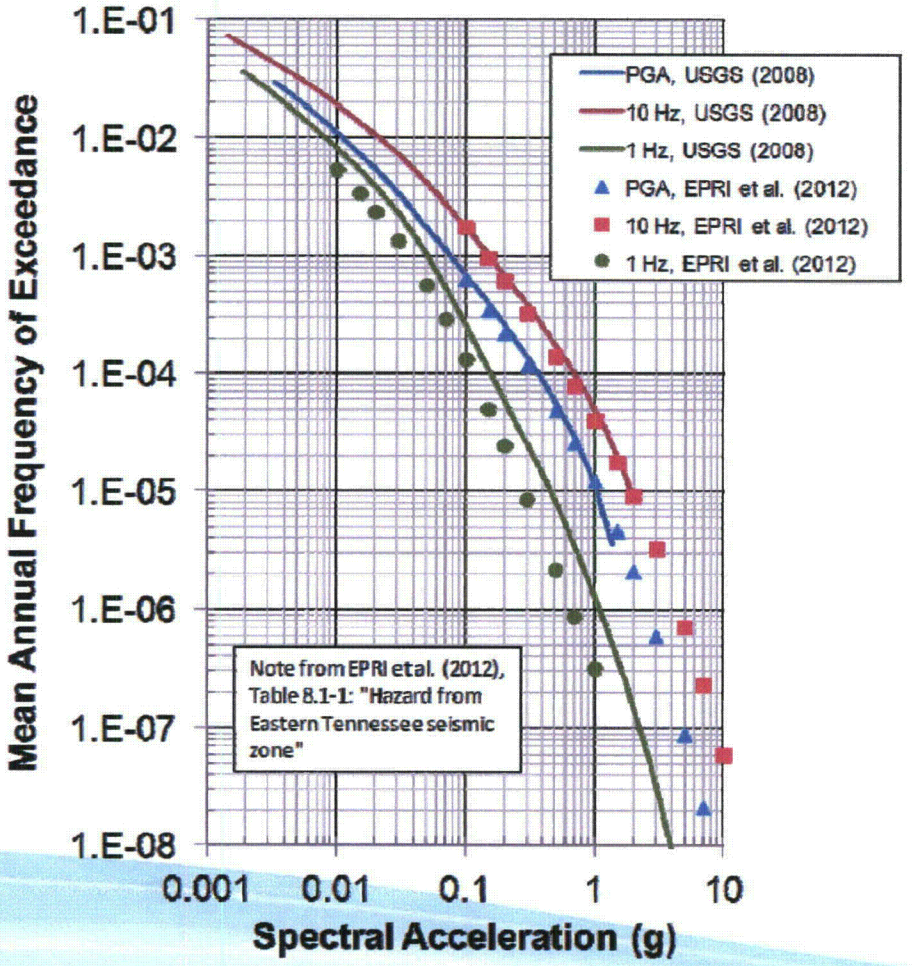
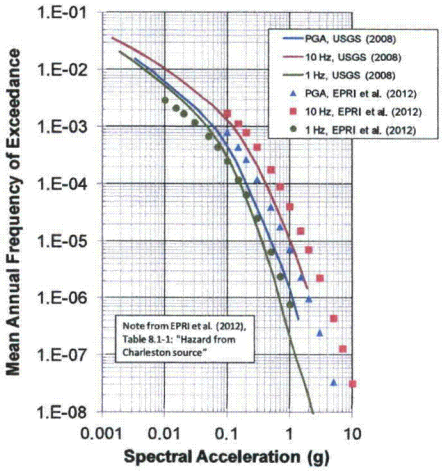
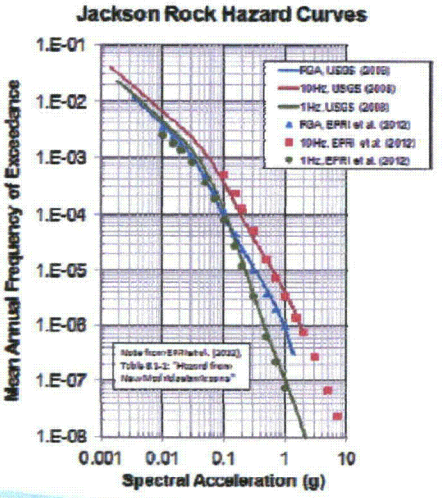
Chattanooga Rock Hazard Curves



Savannah Rock Hazard Curves



Jackson Rock Hazard Curves



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USGS-EPRI PGA Comparison

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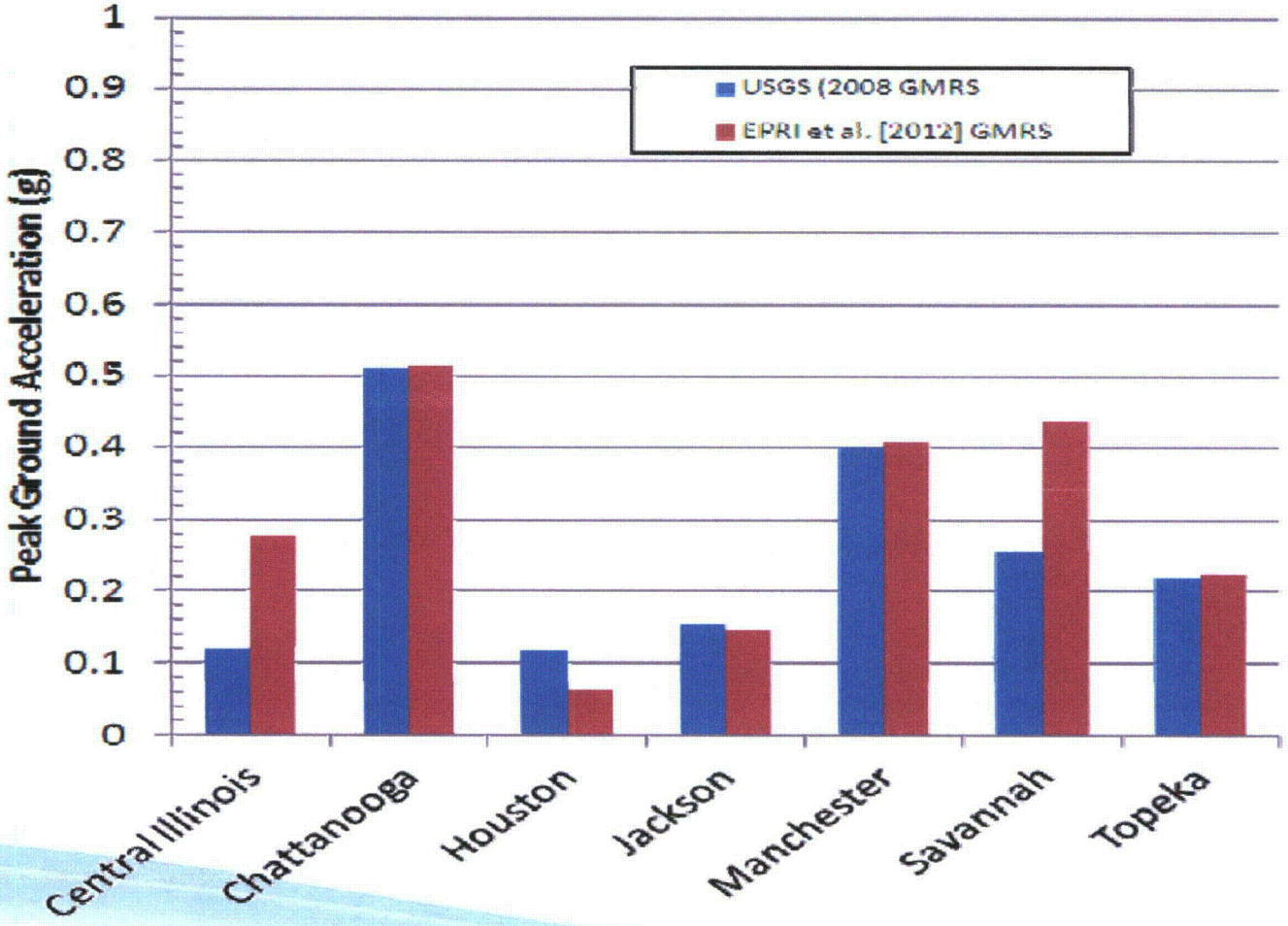

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USGS-EPRI 10 Hz Comparison

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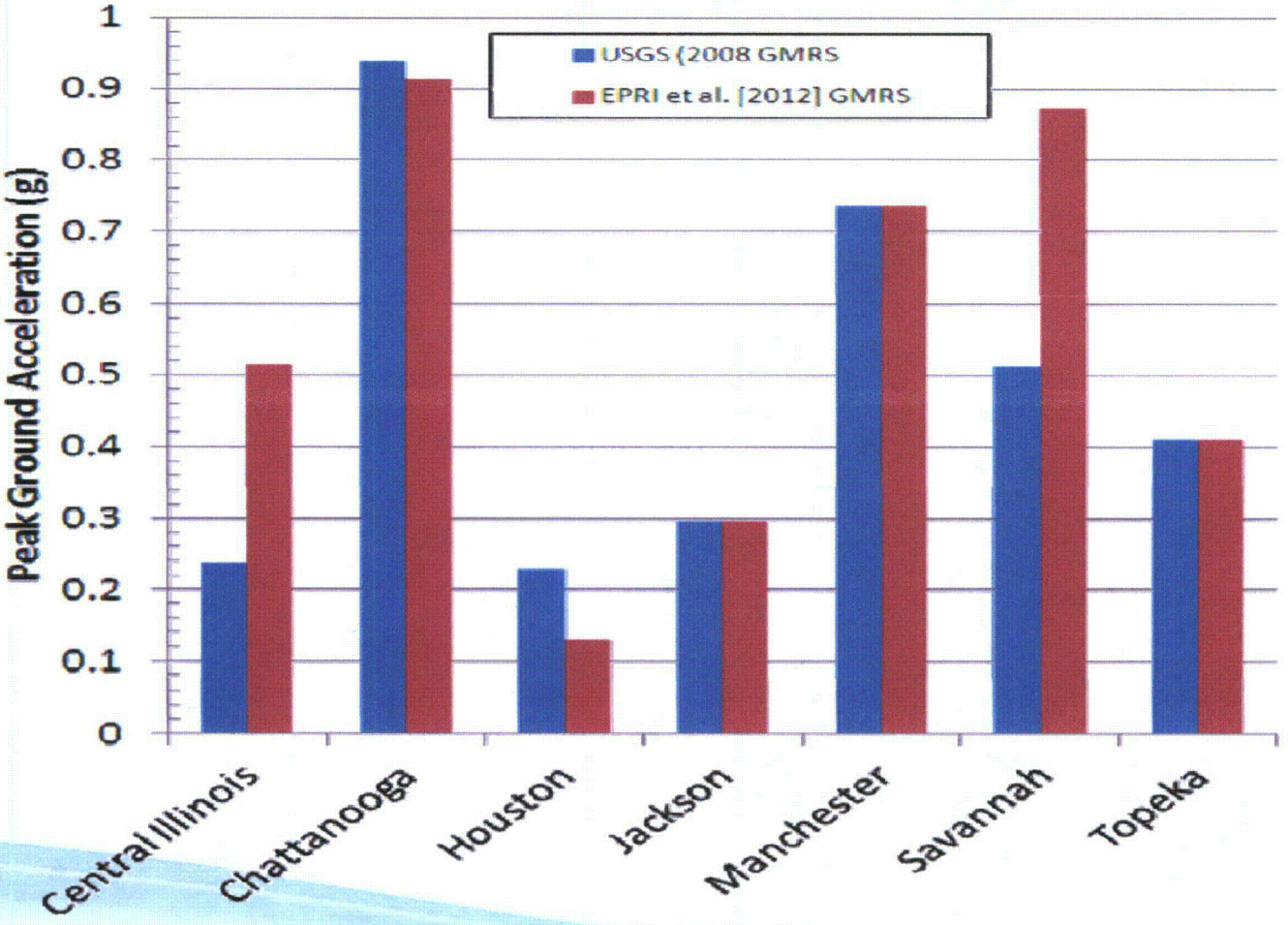

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USGS-EPRI 1Hz Comparison

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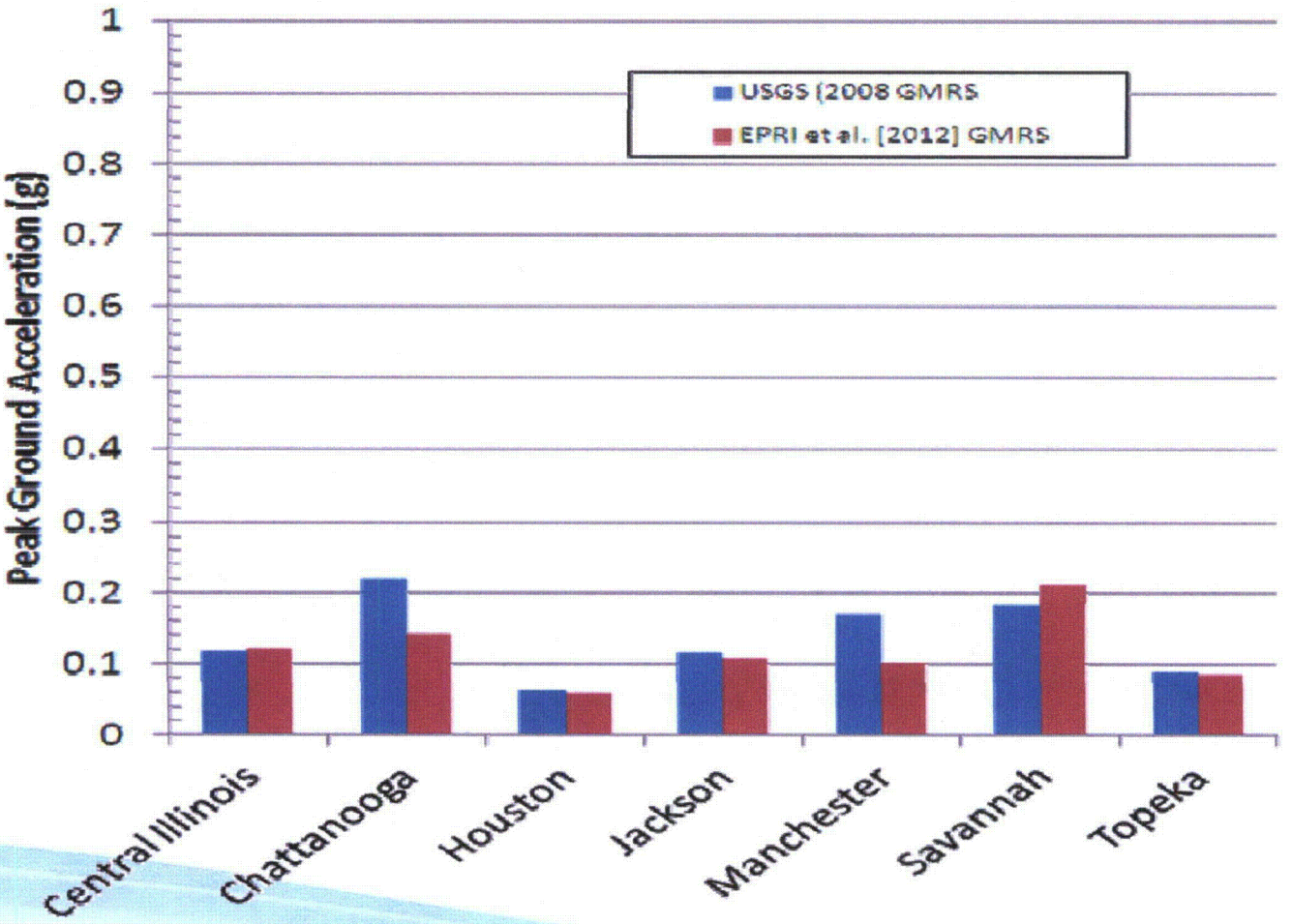

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Rock GMRS

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Manchester GMRS

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Central Illinois GMRS

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[CCI per Affidavit 4(a)-(d)]

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Topeka GMRS

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[CCI per Affidavit 4(a)-(d)]

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Houston GMRS

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Jackson GMRS

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Savannah GMRS

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Chattanooga GMRS

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SSI Analysis Using SASSI

Farhang Ostadan

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SSI Analysis

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SSI Analysis Approach

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SSI Analysis

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SSI Analysis

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SASSI2010 - RVT

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SASSI2010 - RVT

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SASSI2010 - RVT

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[CCI per Affidavit 4(a)-(d)]

generation mPower

SASSI Subtraction Method

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SASSI Subtraction Method

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SASSI Subtraction Method

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SSI Modeling Studies

Lisa Anderson

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SSI Studies

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2-D Planar Model

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Backfill Retaining Wall Study

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Backfill Retaining Wall Study

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Eastern Tennessee Input Study

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Eastern Tennessee Input Study

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Berm Configuration Study

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Berm Configuration Study

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Separation Distance Study

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Separation Distance Study

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SSI Studies

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Nuclear Island SSI Model

Mike McHood

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Nuclear Island SSI Model

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Nuclear Island SSI Model

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SSI Modeling Overview

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Structural Analysis and Design Plan

Jack Demitz

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Structural Analysis Plan

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Structural Analysis Plan

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Structural Analysis Plan

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Structural Design Plan

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Structural Design Plan

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Considerations for Groundwater and Probable Maximum Flood

Jack Demitz

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Considerations for Groundwater & PMF

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Considerations for Groundwater & PMF

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Recap

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