

Use of NSHMP Products for Site-Specific Hazard Analyses for Critical Structures

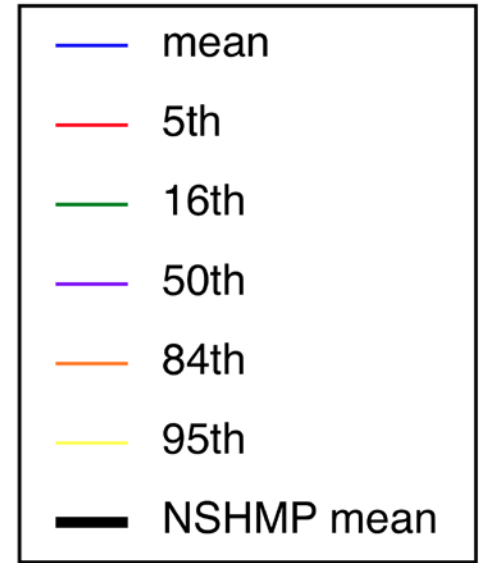
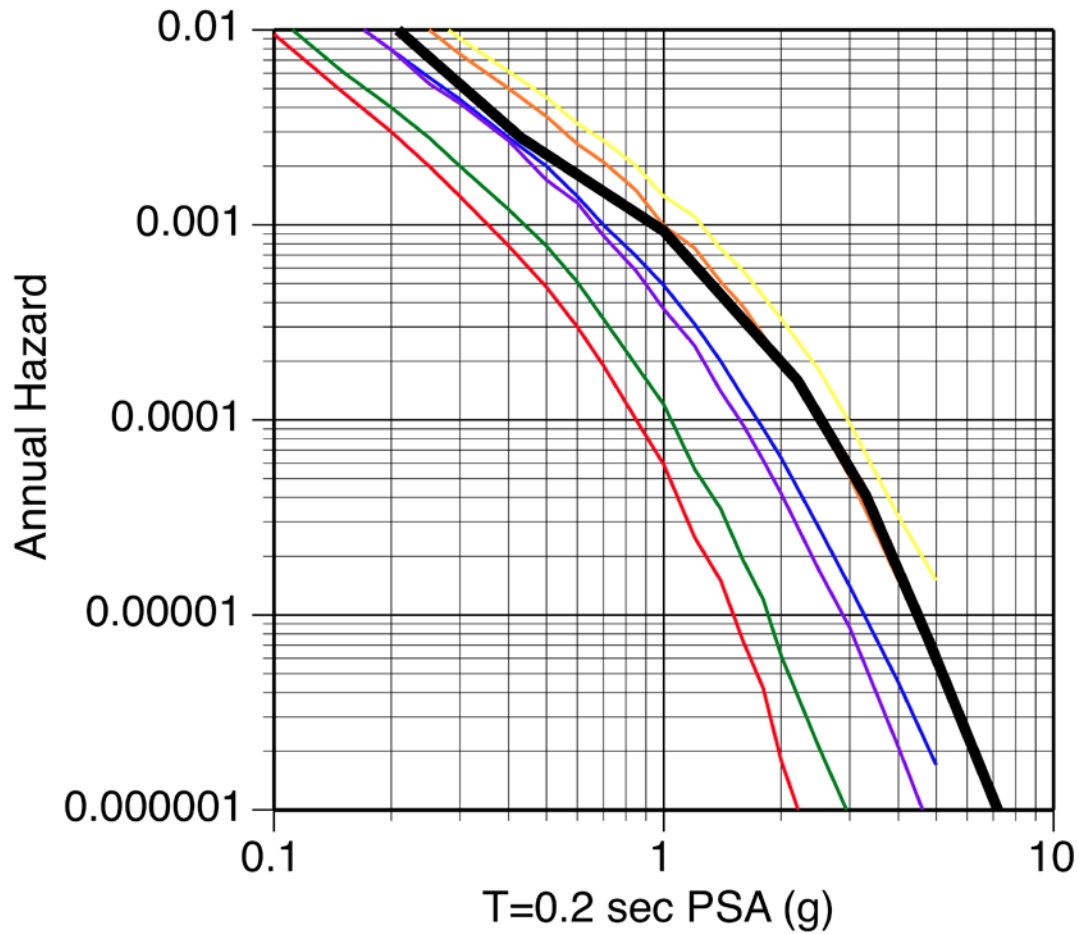
N. Abrahamson

PG&E

ATC – USGS Workshop Sept 21-22, 2015

Issues

- Deterministic approaches still used for some critical structures
 - Dams (FERC, DSOD)
 - Hazardous waste landfills
- Scale of features in the SSC model
 - Are smaller features captured in the model?
- GMPE evaluation
 - Applicability to a site versus applicability to broad region
- Hazard calculation methods for low probability levels ($1E-4$ to $1E-7$)
 - Some simplifications that are reasonable for $4E-4$ hazard levels (2% in 50 yrs) do not work at low probability levels
- Uncertainty
 - More emphasis on epistemic uncertainty, rather than mean hazard, for critical structures



Use of Uniform Hazard Maps for Critical Structures

- Site-Specific Evaluation Required
 - Need to consider smaller scale faults or zones that may not be captured in the national maps
 - Faults with $M_{\max} < 6.5$
 - Concentration of smaller earthquakes on faults or smoothed in zones
- NSHMP Uniform Hazard Maps
 - Not used determining the ground motions or hazard curves
 - Peer reviewers would not allow simply using the mapped values
 - Often used to compare with the site-specific results
 - Should be able to explain the causes of the differences

Use of SSC Inputs to NSHMP

- NSHMP SSC parameter values are considered in the development of the SSC logic tree
- Updating the NSHMP SSC values
 - Site-specific study will often update the values using new data or models
 - For complex SSC models (e.g. UCERF3), it can be difficult to update a small region of the model

Earthquake Catalogs

- NSHMP catalogs can be used as a starting point
 - Updated with new earthquakes

GMPEs

- NSHMP selection and weights
 - Need to apply to the broad region
- Site-specific selection and weights
 - Should be optimized for the controlling sources
 - e.g. hazard controlled by normal faulting
 - e.g. site is located over the HW

Aleatory Variability

- Ergodic vs non-ergodic
 - NSHMP uses ergodic models
 - Critical structures usually include a site-specific site response analysis
 - Use partially non-ergodic models (single-station sigma) to avoid double counting the epistemic uncertainty in the site amplification
- Fat-tail Distributions
 - Within-event residuals show fat tails for $\epsilon > 2.5$
 - Mixture model captures fat tails
 - Only affect very low probabilities

Hazard Calculation for Zones

- Distance Metrics
 - Site-specific uses virtual faults or point-source corrections to compute the distances (RRUP, RJB)
 - Leads to shorter distances that can affect hazard at low probability levels
- Depth distribution
 - Site-specific studies include finer sampling in depth and alternative models

Hazard Calculation for Faults

- Smaller faults included
 - Fault with $M_{max} < 6.5$ are included
- Directivity
 - No agreement in how to handle directivity, but site-specific analyses often include directivity

Summary

- Critical structures require site-specific analyses, which limits the use of NSHMP products
- SSC Inputs from the NSHMP can be useful for developing the site-specific logic tree
- GMPE evaluation for the NSHMP may be considered for site-specific, but emphasis is on application to controlling sources
- Hazard calculation need to address models that affect only the very low probabilities