Ground Motion Prediction Equation
Hazard Sensitivity Results for Palo Verde Nuclear Generating Station Site (PVNGS)

M. Walling
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Hazard ground motion prediction equation (GMPE) sensitivity results

- Base Case
- Sensitivity Tests
  - GMPE’s
  - Sigma Mixture Model
  - Tau, Single Station Sigma (PhiSS), Single Station Path (PhiSP)
- Local Source Effects 0 – 200 km
- Distant Source Effects 200 – 400 km
- Results
  - PGA AFE 10-4 and 10-6
  - 0.5 Hz AFE 10-4 and 10-6
Base Case Faults

- Over 30 faults sources
- Main fault contributor is Cerro Prieto (*)

* Spelling corrected after Workshop #3
Base Case Background Sources

- 11 Background Zones
- Uniform rate of earthquakes
- Host source is the main background zone contributor
Base Case Ground Motion Prediction Equations

- Ground Motion Prediction Equations
  - 5 NGA (2008) GMPEs
    - Abrahamson and Silva
    - Boore and Atkinson
    - Campbell and Bozorgnia
    - Chiou and Youngs
    - Idriss
  - Equally weighted with Epistemic Uncertainty
  - $V_{s30m} = 760 \, \text{m/sec}$
GMPE Sensitivity

- Local source effects
  - Normal Fault Mechanism
  - GMPE’s 5 NGA-W1&2, 2013AK, 2013BN (*)

- Distant source effects
  - GMPE’s 5 NGA-W1&2, 2006ZH, 2006ZH Modified for M>7.1

* Corrected after Workshop #3
Sensitivity to GMPE PGA & 0.5 Hz at AFE

1E-4

Ratio of GMPE's /BASE CASE

Distant

Local
Sensitivity to GMPE PGA & 0.5 Hz at AFE

1E-6

Ratio of GMPE's /BASE CASE
Sensitivity to Sigma Mixture Model

- Combination of two normal distributions
- Sigma = 0.58 and 0.72
- Effect is fat tail ~ 0.65
- Local source effects sensitivity
  - Results for PGA, 0.5 Hz
  - 1E-4
- Distant source effects sensitivity
  - Results for PGA, 0.5 Hz
  - 1E-4
Tornado Plot 1E-4 Sigma Mixture

Mixture of two normal distributions with sigma = 0.58 and 0.72
Sensitivity to Tau Model

- Tau Model – Linda to discuss Wednesday
- Local source effects sensitivity
  - Results for PGA
  - 1E-4
- Distant source effects sensitivity
  - Results for 0.5Hz
  - 1E-4, 1E-6
Tornado Plot 1E-4 Tau Model

Showing Epistemic Uncertainty in Tau Model

PGA - Sensitivity

Ratio of GMPE's /BASE CASE

0.2

2.0
Showing Epistemic Uncertainty in Tau Model

**Tornado Plot 1E-4 Tau Model**

**0.5 Hz Sensitivity**

- **Upper - Distant + Base Local**
- **Median - Distant + Base Local**
- **Lower - Distant + Base Distant**

**Ratio of GMPE's / BASE CASE**

0.2 to 2.0
Tornado Plot 1E-6 Tau Model

Showing Epistemic Uncertainty in Tau Model

0.5 Hz Sensitivity

- Upper - Distant + Base Local
- Median - Distant + Base Local
- Lower - Distant + Base Distant

Ratio of GMPE's / Base Case
Sensitivity to Single Station Sigma Model

- PhiSS – Linda to discuss Wednesday
- Local source effects sensitivity
  - Results for PGA
  - 1E-4, 1E-6
- Distant source effects sensitivity
  - Results for 0.5Hz
  - 1E-4, 1E-6
Local Source Sensitivity 1E-4 PhiSS Model

Showing Epistemic Uncertainty in PhiSS Model

PGA - Sensitivity

Ratio of GMPE's /BASE CASE
Local Source Sensitivity 1E-6 PhiSS Model

Showing Epistemic Uncertainty in PhiSS Model

PGA - Sensitivity

- UPPER - LOCAL
- +BASE DISTANT
- MEDIAN - LOCAL + BASE DISTANT
- UPPER - LOCAL +BASE DISTANT

Ratio of GMPE's /BASE CASE

0.2

2.0

Local
Distant Source Sensitivity 1E-4 PhiSS Model

Showing Epistemic Uncertainty in PhiSS Model

0.5 Hz Sensitivity

- **UPPER - DISTANT + BASE LOCAL**
- **MEDIAN - DISTANT + BASE LOCAL**
- **LOWER - DISTANT + BASE DISTANT**

Ratio of GMPE's / BASE CASE

Distant
Distant Source Sensitivity 1E-6 PhiSS Model

Showing Epistemic Uncertainty in PhiSS Model

0.5 Hz Sensitivity

Ratio of GMPE's /BASE CASE

0.2

2.0

Distant

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Earth Science Consultants
Sensitivity to Path effects

• Sigma Single Station Path (PhiSSP) – Linda to discuss Wednesday
  ▪ North Path
  ▪ South Path
• Results at 0.5 Hz 1E-4 Hazard
• Epistemic Uncertainty
  ▪ Upper PhiSSP
  ▪ Median PhiSSP
  ▪ Lower PhiSSP
Tornado Plot 1E-4 PhiSP Model

Showing Epistemic Uncertainty in PhiSP Model

0.5 Hz Sensitivity

Ratio of GMPE's /BASE CASE
References

- Akkar, S., M.A. Sandikkaya, and J.J. Bommer (2013). Empirical ground-motion models for point- and exetended-source crustal earthquake scenarios in Europe and the Middle East, Bull Earthquake Eng., online publication
- Campbell, K.W., and Bozorgnia, Y. (2008). NGA Ground Motion Model for the Geometric Mean Horizontal Component of PGA, PGV, PGD and 5% Damped Linear Elastic Response Spectra for Periods Ranging from 0.01 to 10 s, *Earthquake Spectra*. 24, 139-171.