Theoretical collapse risks, ground motion return periods, and largest values from current and alternative $MCE_R$ ground motion maps

**Building Seismic Safety Council (BSSC) Project ‘17 Meeting on Acceptable Risk**

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**Kenneth Rukstales**, GIS Analyst

*Including requests from Bob Pekelnicky et al*

**USGS—Golden, CO**
Current (ASCE 7-16): Risk-targeted (1%-in-50yrs) w/ deterministic cap

- Alternative: Deterministic w/ uniform-hazard (975yr) floor
- Alternative: Uniform-hazard (975yr)
- Alternative: Uniform-hazard (1500yr)
- Alternative: Risk-targeted (1-to-3%-in-50yrs)
- Alternative: Risk-targeted (1%-in-50yrs) using a fragility w/ 5% probability of collapse at MCE_R

Note: For brevity, only short-period (0.2s) results are presented.
Collapse Risks from Current MCE\textsubscript{R} Maps

“Theoretical collapse risks, ground motion return periods, and largest values … ,” N. Luco et al (USGS) September 28, 2016
Collapse Risks from Current MCE$_R$ Maps

40°N

35°N

115°W

120°W

0.99% - 1.10%
1.10% - 2.00%
2.00% - 3.00%
3.00% - 5.00%
5.00% - 9.45%

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Collapse Risks from Current $MCE_R$ Maps

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Return Periods of Current MCE$_R$ Maps

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Collapse Risks from Alternative Maps

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"Theoretical collapse risks, ground motion return periods, and largest values ... ," N. Luco et al (USGS)  
November 22, 2016
Collapse Risks from Alternative Maps

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Building Seismic Safety Council (BSSC) Project ‘17 Working Group on Acceptable Risk

“Theoretical collapse risks, ground motion return periods, and largest values ...,” N. Luco et al (USGS) November 13, 2016
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Reference

A RISK-TARGETED ALTERNATIVE TO DETERMINISTIC CAPPING OF MAXIMUM CONSIDERED EARTHQUAKE GROUND MOTION MAPS

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## Largest Ground Motion Values

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Largest $S_S$</th>
<th>In ASCE 7-22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current (ASCE 7-16)</td>
<td>3.3g</td>
<td>New Madrid, MO (36.60, -89.60)</td>
</tr>
<tr>
<td>Deterministic w/ 975yr floor</td>
<td>5.3g</td>
<td>Meers, OK (34.75, -98.40)</td>
</tr>
<tr>
<td>Uniform-hazard (975yr)</td>
<td>3.7g</td>
<td>Imperial Valley, CA (32.85, -115.50)</td>
</tr>
<tr>
<td>Uniform-hazard (1500yr)</td>
<td>4.2g</td>
<td>Imperial Valley, CA (32.85, -115.50)</td>
</tr>
<tr>
<td>Risk-targeted (1-3% in 50yrs)</td>
<td>3.0g</td>
<td>Imperial Valley, CA (32.85, -115.50)</td>
</tr>
<tr>
<td>Risk-targeted (1% in 50yrs) w/ 5% fragility</td>
<td>3.7g</td>
<td>Imperial Valley, CA (32.85, -115.50)</td>
</tr>
</tbody>
</table>
Straw Poll of Working Group

• 5 favor returning to Uniform Hazard
  – 4 chose 1,500 year
  – 3 voted 1,500 as a second choice
• 3 favor keeping current $\text{MCE}_R$ definition
• 2 favor going to 1% to 3% variable risk
  – One other member expressed this is second choice
Reasons to go to 1,500 year

• Avoids using a fragility curve
• Avoiding the risk calculation, the GM computations are simplified
• Avoids deterministic areas, removing the wide variations in collapse probabilities observed now
• Achieves a surprisingly consistent degree of mean collapse risk regardless of hazard level
Reasons to go to 1% - 3% Variable

• MCE definition is based on the performance of the buildings
• It is reasonable/justifiable to design buildings in high seismic regions for a higher collapse risk
Reasons to Stay w/ Current MCER

- No change
- Does not create another “yo” in the yo-yo issue
- Alternates produce too big a drop
- While there are opportunities for marginal improvement, changing the target without a very compelling reason will create more problems than it solves.