

# FOREWORD

This special themed issue of *Earthquake Spectra* is devoted to the ShakeOut Scenario and its impact on preparedness. A recent effort led by the U.S. Geological Survey and the California Geological Survey created the scenario, which hypothesizes the occurrence and effects of an  $M_w$ 7.8 earthquake on the southern San Andreas Fault. It depicts a single deterministic outcome in terms of shaking intensity and ground failure; building damage and loss of function; impacts on lifelines, such as roads and water supply; deaths and injuries; property and business interruption losses; emergency response recovery; and public policy. See the first manuscript in this issue, by Porter et al., for an overview. Like previous scenarios, the ShakeOut aims to inform preparedness planning and mitigation decision-making, but it is novel in several ways:

- Its objective is to show how science can enhance community resilience. To that end, it employs both cutting-edge research and broadly accepted professional practice. As one example, Graves et al. discuss how ground-motion estimates, typically developed from seismic attenuation relationships, were instead developed using physics-based modeling. Four teams calculated wave propagation from kinematic and dynamically modeled rupture through the earth's crust to a grid of points on the earth's surface. Star et al. compare the results with NGA estimates. Treiman and Ponti present details of surface faulting. As another example, Goltz and Mileti show how activities in 17 functions of public policy, emergency response, and recovery are characterized at six points in time after the earthquake, depicted in a new format showing both spontaneous actions by victims and organized actions by professionals.
- It adds the expertise of social science, local government, and business to the traditional scenario domains of earthquake science, geotechnical engineering, and structural engineering. The breadth and scope of the economic consequences study is unprecedented, with an extensive analysis of business interruption, resilience, and recovery, as described in manuscripts by Rose et al., Wein and Rose, and Wein et al.
- It uses a groundbreaking sociological study and social networking (e.g., YouTube and Facebook) to enhance the outreach effort (Jones and Benthien). As detailed in Perry et al., it employs a suite of nontraditional communication efforts that include professional design and marketing and user-specific products to promote participation and preparedness.
- Physical impacts are estimated using software such as HAZUS<sup>®MH</sup>, but unlike prior work, model estimates are supplemented or replaced by 18 focus studies, panel discussions, or a combination of the two. The focus studies address, among other topics, steelframe buildings (Krishnan and Muto), woodframe buildings (Graf and Seligson), impacts on the rail network (Byers), and the potential for fire following earthquake (Scawthorn).
- Porter and Sherrill show how panels of more than 100 operators, engineers, and other experts from affected utility and lifeline agencies estimated the damage and

restoration activities of those lifelines, There are many indications that panelists' involvement led them to take the scenario more seriously than if it had been developed by outsiders.

- The ShakeOut has inspired subsequent hazard and risk research, such as on fault-displacement hazards (Chen and Petersen), concrete buildings (Liel et al.), water supply (Davis and O'Rourke), reconstruction materials (Langer), and group reactions to the exercise itself (Rosoff et al.).
- The Scenario goes beyond describing outcomes. In most topics, it notes research needs and two or three practical measures—often proposed by stakeholders—to prepare for or physically reduce the negative impacts of a large earthquake.
- In total, 300 practitioners, academics, and government technical experts from 50 organizations prepared the most extensive earthquake-planning scenario ever created for California. A list of contributors is provided at the end of the Porter et al. manuscript.
- Jones and Benthien discuss how the scenario was coupled with emergency response and recovery exercises, seminars, and an outreach effort that involved 5.5 million people—roughly 1 in 4 Southern Californians. The ShakeOut exercise has become an annual event in California.
- Use of the Scenario and its outreach methodology continues and expands. Participation has grown annually, reaching 7.9 million in 2010. “ShakeOut” has become an international, generic term meaning a large public earthquake-preparedness exercise, having been adopted in New Zealand, Canada, the central United States, Nevada, Guam, and Oregon. FEMA recently completed a catastrophe plan for Southern California based on the ShakeOut Scenario. California's 2012 Golden Guardian exercise, like the 2008 exercise, will be based on the ShakeOut Scenario.

What seems to have made the most immediate difference in preparedness is the synergy between the ShakeOut Scenario study and the earthquake exercises, and the deliberate design of the scenario by and with end users (see Perry et al.). Millions of California schoolchildren annually practice drop-cover-and-hold drills during the ShakeOut exercise. Large and small businesses have exercised and enhanced their emergency plans in light of the ShakeOut. California lifeline agencies have increased their stocks of emergency supplies and spare parts and added backup communications capabilities, using the lessons they learned through the ShakeOut (see Porter and Sherrill). Some of those lessons come from examining more closely the interaction between lifelines. Some come from more skeptically questioning their ability to recover quickly, in order to avoid overpromising the public on recovery—an activity that would not have arisen if the ShakeOut had not been a statewide exercise, involving many segments of society in a single exercise.

The idea of using science to enhance preparedness, seismic resistance, and community resilience seems particularly appropriate in light of the 2004 Sumatra earthquake, 2010 Haiti earthquake, and 2011 Christchurch and Tohoku (Japan) earthquakes, as well as the upcoming bicentennial of the 1811–1812 earthquakes that originated in the New Madrid Seismic Zone. Like the ShakeOut Scenario earthquake, these actual events were disasters beyond the living memory and the planning periods of the affected populace. Coordinated, integrated research across the relevant disciplines could help to improve the outcomes in

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affected societies. We believe that a populace practiced in responding to imaginary disasters is better prepared to respond to real ones, with fewer mistakes and a greater probability of taking appropriate actions. Governments and businesses will be better armed with well-considered, pertinent plans, fresh in their corporate memories. Critical lifeline agencies will be better stocked with spare parts, better backup communications capabilities, more cogent mutual-aid agreements, and fewer illusions about how much they can rely on those agreements and on other lifelines. Local governments will be more prepared to adopt and strictly enforce building codes that prudently balance construction costs now with reduction in future losses, when earthquakes and other natural disaster occur. Nature will inevitably strike, probably without warning, but if we have thoroughly prepared ourselves with scenarios and exercises like the ShakeOut, we will not be defenseless.

### ACKNOWLEDGMENTS

Forewords do not usually have acknowledgments, but one is warranted here. Although the ShakeOut Scenario was the outcome of the work and dedication of hundreds of people, it exists because of the scientific leadership of Lucile Jones and the project management of Dale Cox within the U.S. Geological Survey's Southern California Multi-Hazards Demonstration Project.

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