

READY By Capt. Larry Collins TO SHAKE?

**Lessons from earthquake exercises
can be applied to many regions**

The Loma Prieta Earthquake struck the San Francisco Bay Area on Oct. 17, 1989. The 6.9-magnitude earthquake caused the collapse of major roadways, including the Cypress viaduct in West Oakland. A 7.8-magnitude earthquake is expected to cause damage unseen by any earthquake in U.S. history.



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More than 5,000 firefighters and first responders participated in the nation's largest disaster exercise Nov. 13–16, 2008. A combined exercise known as the Great Southern California ShakeOut and

Operation Golden Guardian 2008, the event involved a simulated 7.8-magnitude earthquake on the southern section of the San Andreas Fault, resulting in catastrophic damage across eight counties.

DESIGNING THE EXERCISE

The ShakeOut's 4-day disaster simulation and readiness exercise were based on the "ShakeOut Earthquake Scenario," a study conducted over a 2-year period by seismologists, engineers, firefighters, disaster response agencies and others. The 289-page study (available for download at www.usgs.gov) highlights the most probable effects of a catastrophic San Andreas Fault earthquake. Using the study as a guide, the exercises were designed as a tool against which fire departments, rescue organizations and other public safety agencies could test their readiness.

In an effort to mitigate the costs and logistical challenges associated with conducting an emergency exercise of this magnitude, the ShakeOut Steering Committee joined with the organizers of "Operation Golden Guardian," a mandated local/state/federal annual event that typically includes a series of seminars, tabletop exercises and full-scale manipulative response exercises to test the government's ability to manage natural and manmade disasters. The union formed one of the largest emergency exercises in history.

BRINGING THE STUDY TO LIFE

As it has long been recognized that firefighters and rescue team members are often best (or at least more comfortable) reacting to actual incidents or concrete examples of actual incidents, the ShakeOut Earthquake Scenario thoroughly detailed the science-based story of a San Andreas Fault quake, going far beyond the hypothetical situations that are sometimes used as the basis for disaster exercises.

Following is a selected passage from the ShakeOut Earthquake Scenario: *"Thursday, Nov. 13, 10:00:30 a.m.: As the earthquake's rupture front travels up the fault, it sends out seismic waves that shake the ground, shifting emergency generators, overturning computers, cracking airport runways and igniting fires ... Many older concrete buildings quickly collapse, trapping occupants. The rupture front continues its advance to San Geronio Pass and dismantles the 10 miles of Interstate 10 freeway that straddles the San Andreas Fault."*

Another passage examines search-and-rescue operations: *"Once locally organized search and rescue teams arrive at the scene of collapsed structures, they are likely to encounter ongoing search and rescue efforts by*

spontaneously formed groups who provide informal briefings to the organized teams and continue to work in cooperation with the organized responders. ... Some search and rescue teams as well as spontaneous volunteers have been forced to abandon efforts to rescue people trapped in the debris due to rapidly approaching fires."

On the topic of fire, the ShakeOut Earthquake Scenario accompanied a sister study conducted by Dr. Charles Skawthorne (Kyoto University, Japan, and formerly U.C. Berkeley) titled "Fire Following Earthquake." The study provides a stark view of raging urban conflagrations that are expected to cause a secondary catastrophe by burning 133,000 buildings—and that's during normal weather conditions (no Santa Ana winds). Further, some of these conflagrations would likely merge to become "super-conflagrations" that would sweep across parts of the impact area, dwarfing the destruction that occurred in the 1906 San Francisco quake.

In the study, Skawthorne identifies why fire following a significant earthquake could be so destructive and deadly: *"This is due to the correlated effects of a large earthquake, simultaneously causing numerous ignitions, degrading building fire resistive features, dropping pressure in water supply mains, saturating communications and transportation routes, and thus allowing some fires to quickly grow into conflagrations that oustrip local resources. ... Simply put, most fire departments are not sized or equipped to cope with the fires following a major earthquake."*

"[During a scenario like that described in the ShakeOut,] it is estimated that approximately 1,600 ignitions will occur, requiring the response of a fire engine. In about 1,200 of these fires, the first-responding engine will not be able to adequately contain the fire."

NOVEMBER 13

On Nov. 13, while more than 5.2 million citizens conducted the civilian version of the simulated earthquake exercise, fire departments and rescue agencies across Southern California participated by practicing "Drop, Cover and Hold On!" for 2 minutes, conducting mock post-quake jurisdictional damage surveys, and reviewing and practicing their department earthquake procedures.

Fire departments across Southern California practiced opening their Departmental Operations Centers (DOCs) and sending key fire department representatives to their respective city and county Emergency Operations Centers (EOCs) that were also activated full-scale to participate in a mock response to the earthquake. For the mutual-aid regions that cover all of Southern California, regional operations centers also were established. Further, all levels of government, including the Department of Homeland Security and the military, were up and running on this exercise, with the various interface centers and mechanisms operational.

Fire departments conducted and/or participated in dozens of

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PHOTO COURTESY USGS

The ShakeOut involved a simulated 7.8-magnitude earthquake on the southern section of the San Andreas Fault, resulting in catastrophic damage, including structural collapse and super-conflagrations.

physical earthquake simulations. Following are some of the many demonstration exercises that occurred on Nov. 13.

- The Los Angeles Fire Department (LAFD) joined a host of other agencies in a mass-casualty simulation near Holy Cross Hospital in the north San Fernando Valley. This exercise involved hundreds of people acting as injured earthquake victims who needed to be triaged, treated, transported to casualty collection points, sorted and sent to definitive care via ambulance, fire department and National Guard helicopters, and other means.
- The Los Angeles County Fire Department (LACoFD) responded to a simulated report from Miller/Coors of a hazmat problem and collapsed structures and many injuries.
- The Glendale Fire Department and other area agencies conducted a simulated structure collapse search-and-rescue operation with volunteers as trapped victims to help evaluate and test USAR capabilities, firefighting, law enforcement security, public works and the utility agencies working together under a unified command.
- The city of Azusa and the LACoFD and Azusa Police Department simulated the imminent failure of Morris Dam, a large dam in San Gabriel Canyon. This event required the city's EOC to be relocated, and a mock emergency evacuation operation of the areas in the dam's projected inundation zone.
- The city of Huntington Park conducted a large-scale simulation that included operation of the city EOC, evacuations, and triage and treatment of simulated victims by LACoFD firefighters and paramedics.
- The city of Sierra Madre simulated the collapse of a science lab with injuries and a hazmat release.
- The city of Whittier conducted a broad-based earthquake simulation that included the major collapse of a high-rise residential building, a hospital irreparably damaged, a jet fuel line rupture, a sewer main rupture, multiple water main breaks and major structure fires.

LESSONS LEARNED

The lessons learned from the Great Southern California ShakeOut are having an impact on preparedness efforts across California, other states prone to earthquakes and even states that would be requested to provide mutual aid into Southern California when the San Andreas Fault ruptures. As a direct result of the exercises, as well as the studies upon which the drills were based, the California fire services are reevaluating and revising urban conflagration strategies, equipment

and tactics. They're reviewing the mutual-aid system and considering strategies that will expedite the response of resources (including out-of-state resources) to help fight fires, locate and rescue trapped victims, treat and remove the injured to definitive medical treatment, confine hazardous materials releases and perform other critical post-quake functions. Additionally, they're taking a closer look at the civilian role and how first responders can help everyone prepare. This includes improving public education for earthquakes and other disasters, and increasing emphasis on creating and supporting Community Emergency Response Teams (CERTs).

Preparation

First and foremost, all emergency responders must be prepared to protect themselves and their equipment, so they are ready to begin immediate life-saving and property-saving operations when the shaking stops. This means use of the "Drop, Cover and Hold On!" protocol advocated by emergency management experts, and passing the message to others. Specifically, *drop* to the ground, take *cover* by getting under a sturdy desk or table and *hold on* to it until the shaking stops. If there isn't a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building. The main point is to immediately protect yourself as best as possible where you are. In a fire station, it also includes getting away from apparatus that will literally be bouncing around inside the apparatus rooms and then, once the shaking stops, removing equipment from the fire stations before aftershocks begin.

There would be significant advantages to an Early Warning System. P-Wave detectors are currently available, with potential for future integration of a system that Cal Tech, the USGS and some private companies are working on, which would use the California Integrated Seismic Network and other sensors to provide warning of an incoming earthquake. In places distant to the epicenter, tens of seconds of warning would allow fire station doors to be opened before the damaging waves strike, allowing fire and rescue apparatus to be immediately pulled out of the stations. This is currently being investigated by a number of fire and rescue agencies.

The ShakeOut also showed us that a 7.8 earthquake on the San Andreas Fault will be "off the charts" in terms of the experience of most responders today. As Lucy Jones, chief seismologist at the USGS in Pasadena, Calif., explains, responders who are planning for smaller events, like Northridge or Loma Prieta, will be unprepared for the



PHOTO COURTESY USGS

The ShakeOut scenario outlines the likely search-and-rescue operations that will occur immediately following a 7.8-magnitude earthquake, as well as how these operations will change upon the arrival of USAR teams.

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scope of the quake. Thus, firefighters and disaster planners must continue to work hand in hand with seismologists, engineers and others to better define the hazards we face, and to develop effective strategies to deal with those hazards.

Resource Structure

The ShakeOut certainly underscored the significant advantages to having a robust, multi-tiered emergency and disaster response system that allows firefighters to manage a wide range of disasters, including those that require interstate mutual aid.

Earthquakes have had a significant effect on the development of fire service structure over the years. For example, the development of the USAR discipline was a direct outgrowth of the Sylmar, Loma Prieta and Whittier earthquakes (1971, 1989 and 1994, respectively). Local fire departments have developed their own USAR units for disasters, which also serve the role of rescue companies on a daily basis. The development of regional and state USAR programs and teams is also a hallmark of these earthquakes.

And the development of FEMA's system of federalized USAR task forces should be considered one of the most effective government programs ever devised. This national system of teams ready to deploy anywhere in the country at a moment's notice was developed and went operational within just 2 years. This program does what it promised and in a very cost-effective way.

The domestic USAR system is further backed up by a system of USAR teams in other nations that can be requested if needed. The United States, under the auspices of the U.S. Agency for International Development (Office of Foreign Disaster Assistance), fields two of

States of Disaster

SoCal & Midwest states must be prepared for the "Big One"

In California, a state where disaster seems part of the backdrop of everyday life, the 1,000 mile-long San Andreas Fault remains the single largest threat of all. Further, the southernmost segment of the San Andreas Fault has gone more than 300 years without breaking. This 300-mile long segment ruptures, on average, every 150 years, so it's long overdue for a large quake.

Shifting to the Midwest, in 1811 and 1812, a series of earthquakes estimated to have approached magnitude 8 struck an eight-state impact area now known as the "New Madrid Fault Zone," which covers parts of six states: Illinois, Missouri, Arkansas, Kentucky, Tennessee and Mississippi. Today more than 44 million people call this area home. A similar-sized quake today would certainly be catastrophic, causing unprecedented loss of life, property and infrastructure.

In November 2008, FEMA and a group of research partners released a new report titled "Impact of Earthquakes in the Central USA," based on a study of the likely effects of a devastating 7.7 earthquake on the New Madrid Fault Zone. It surmises the likelihood of a magnitude 6 or 7 earthquake in the foreseeable future, and possibly something much larger beyond.



The LACoFD's Regional USAR Task Force is tested on search cutting and breaching operations during one of several simulated collapses.

those international teams. *Note:* The two U.S.-based international USAR task forces are from the Fairfax County (Va.) Fire and Rescue Department and the LACoFD.

Even with these systems, the number of structure collapses across Southern California anticipated by the ShakeOut Scenario will challenge all available rescue systems.

In addition to USAR teams, our paramedic and other emergency pre-hospital care systems are among the best anywhere. We enjoy sophisticated systems to care for victims of disasters, including being able to treat people still trapped and quickly move them to the appropriate medical facilities. In disasters, the local systems are backed up by local and federally deployable medical teams, including those from the National Disaster Medical System. Still, the number of injuries may be overwhelming initially and will require a massive response.

Firefighting

Southern California has developed one of the most robust and time-tested systems for managing urban and wildland/urban interface (WUI) fires. Still, even these fire-tested resources and the mutual-aid system will be severely challenged—and in some cases overwhelmed—by 1,600 urban fires igniting within minutes of a 7.8 quake.

This event will certainly challenge local firefighters who will encounter larger fires because of response delays, fewer assisting resources because of simultaneous emergencies, and reduced water for firefighting in some areas because of water main damage and greatly increased demand from other firefighting operations. Consequently, local firefighters and command staffs must be prepared to deal with multiple urban conflagrations, some of which might merge. The use of innovative strategies, unusual tactics (like “indirect attack” and aerial attack in urban firefighting) and massive amounts of mutual aid will be key to limiting the spread of fire.

Civilian Role

The ShakeOut and Golden Guardian highlighted the importance of individual and community readiness. While fire departments are preparing for the potential effects of a San Andreas quake, it's important for the residents of Southern California to prepare for the short- and long-term consequences of a large local quake. Thus, the fire and rescue services and other public safety organizations have committed significant resources to supporting the new public education efforts—and we must continue to do so. For examples of public education programs that originated from this exercise, visit www.shakeout.org.

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Firefighters remove victims from simulated collapsed buildings at the Miller-Coors brewery in Irwindale, Calif.

PHOTO CAPT. LARRY COLLINS/LACOFD



We already know that many lightly trapped victims will be rescued by neighbors and family using whatever tools are available, and the fire service strongly supports development of Community Emergency Response Teams and other means of teaching and equipping residents to conduct light rescues. This will allow firefighters and other rescuers to concentrate their efforts on people seriously trapped.

Additionally, in the case of a 7.8 earthquake, it's going to be important for residents to limit fire ignitions by having earthquake shutoff valves installed at their gas meters, being prepared to manually shut off the gas and having fire extinguishers in their homes, places of work and automobiles (and knowing how to safely use them) in order to extinguish small fires before they spread.

CONCLUSION

The lessons learned from the ShakeOut are clearly not limited to Southern California. To the contrary, decision makers in any region prone to earthquakes will find important parallels in terms of the need for public awareness of local hazards; improved public education to help improve personal readiness of the affected population; well-oiled and robust, multi-tiered emergency response systems; the use of well-considered construction codes and ordinances to improve the performance of structures and lifelines; and the ability of all levels of government and the military to respond quickly, effectively and in unison during disasters. The fire department is part of the front line of response, and the ShakeOut Scenario reminds us of the tremendous challenges we all will face on the day of such an earthquake and for weeks and months afterward. ☺

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For more information

about the Great Southern California ShakeOut, visit www.fire-rescue.com and look for the "Bonus Content" section, where you can read additional passages from the ShakeOut Earthquake Scenario, a more detailed list of activities from the Nov. 13 exercises, a list of recommended solutions for the likely consequences of such an earthquake, as proposed by Los Angeles County's new multi-agency earthquake task force, and more.