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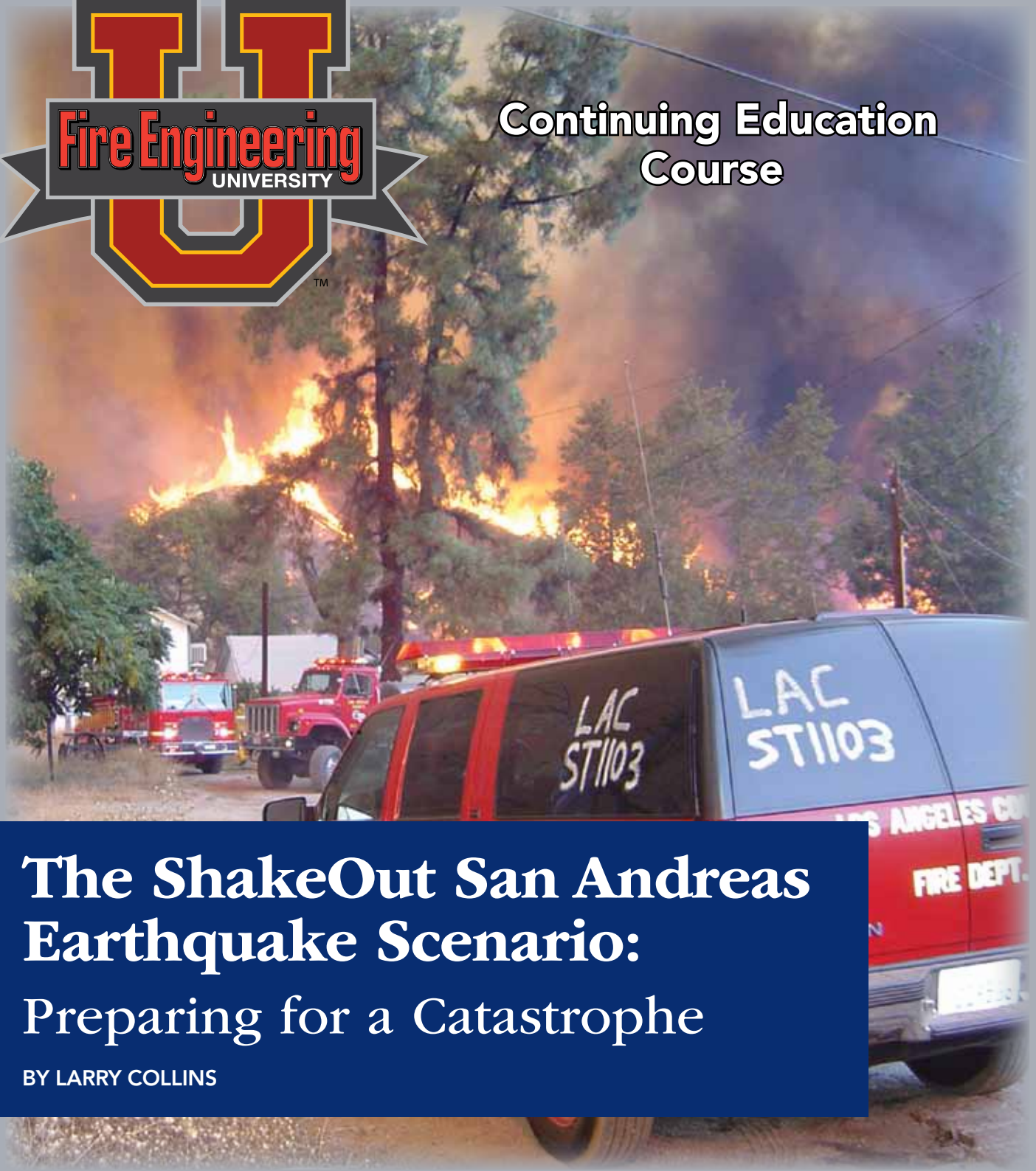

The ShakeOut San Andreas Earthquake Scenario:

Preparing for a Catastrophe

BY LARRY COLLINS

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The ShakeOut San Andreas Earthquake Scenario:

Preparing for a Catastrophe

Educational Objectives

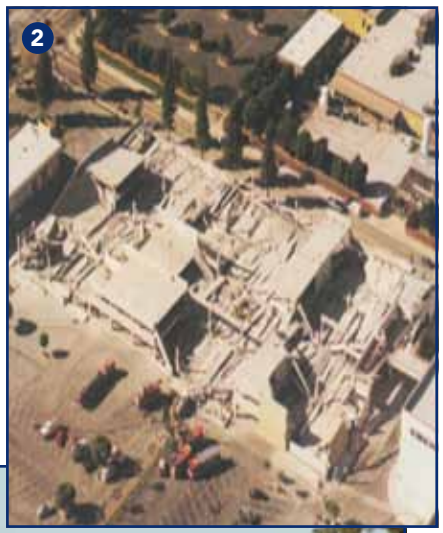
On completion of this course, students will:

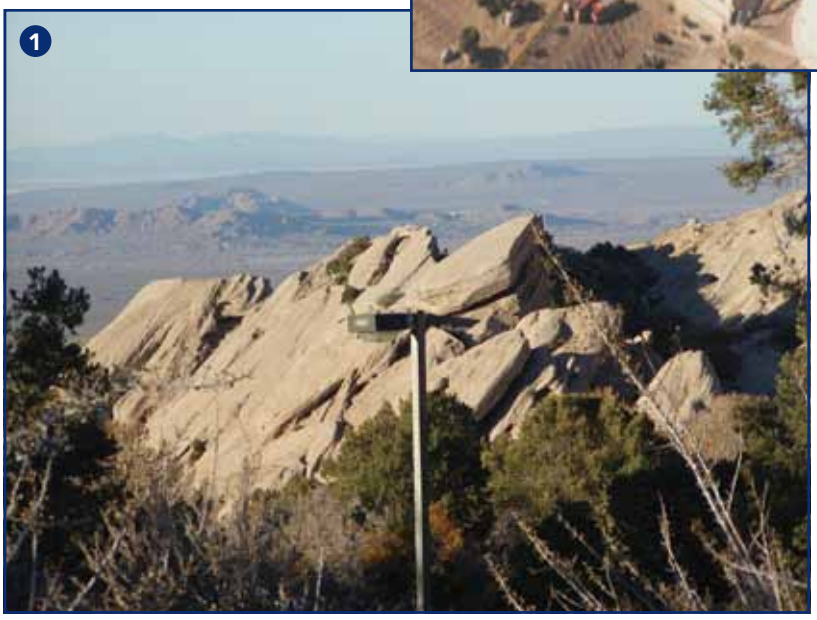
- Identify the implications of a 7.8 or larger earthquake on the San Andreas fault given today's conditions
- Identify the planning issues necessary to conduct an exercise of this magnitude
- Gain an understanding of the role of the local residents
- Understand the relationship/role between various local, state, and federal entities

BY LARRY COLLINS

THE SAN ANDREAS FAULT IS LIKE THE SWORD OF Damocles dangling over California, a constant reminder of catastrophe waiting in the wings. In a state so prone to a wide range of disasters that they seem routine, the thousand-mile-long San Andreas Fault remains the single largest threat. This fault flattened and burned much of San Francisco in 1906; it ruptured for hundreds of miles and severely rocked the land for nearly three minutes in 1857 (when Los Angeles was a little town along a river); and it's responsible for the 11,000-foot mountain ranges that account for the wind, rain, and fire conditions that cause other forms of disaster.

Nowhere is the danger of impending catastrophe more palpable than in Southern California, where the southernmost segment of the San Andreas Fault has gone more than 300 years without breaking. This segment ruptures every 150 years on average, so it's long overdue for a very large quake. In the parlance of one seismologist, the San Andreas Fault "is 18 months pregnant."





(1) The San Andreas fault between the moutain town of Wrightwood and Highway 15. (Photos by author.)

(2) The ShakeOut Earthquake Scenario anticipates thousands of structure collapses across eight counties.

THE SHAKEOUT SCENARIO

What effect will a 300-mile-long, 30-foot rupture of the San Andreas Fault in California have on 20 million people, the buildings they live in, and the ground their cities are built on? It's long been understood that such a quake would be devastating, but that wasn't enough for post-9/11 and post-Katrina catastrophe planning measures in the United States. To get a better handle on the seismic effects and resultant potential consequences of such an event, the U.S. Geological Survey (USGS), two years ago, commissioned the

most detailed study ever of the San Andreas Fault.

The goal was to develop an earthquake scenario all levels of government, the public, and the business community could use to plan for the eventual disaster that will certainly strike. The ultimate goal of what has come to be known as the ShakeOut Scenario was to determine how we can mitigate the effects of such a disaster and, hopefully, develop strategies to short-circuit some of the post-quake effects that would multiply the damage and life loss if effective steps are not taken before and after the quake.

Dr. Lucile Jones, chief scientist of the USGS Multi-Hazards Demonstration Project for Southern California, heads the ShakeOut Scenario project, which is to bridge the gap between hazards science, the main mission, which traditionally was to investigate and describe hazards and prescribe mitigation measures, and emergency response, whose task of managing emergencies and disasters can in many cases be made easier and more effective through a better understanding of the hazards. The ultimate goal of this consolidated multidisciplinary effort is to increase our society's resiliency in any kind of disaster,[1] which is also a national security goal.

(3) Search and rescue operations would in many cases be complicated by collapsed buildings already on fire or threatened by urban conflagration.

The open file report on the ShakeOut Scenario states:

> Scientists of the USGS changed the way that earthquake scenarios are done, uniting a multidisciplinary team that spans an unprecedented number of specialties. The team includes the California Geological Survey; the Southern California Earthquake Center; and nearly 200 other partners in government, academia, emergency response (including fire department officers and chiefs), and industry, working to understand the long-term impacts of an enormous earthquake on the complicated social and economic interactions that sustain southern California society. This project has applied the best current scientific understanding to identify what can be done now to avoid an earthquake catastrophe.[2]

The USGS open file report is accessible to everyone at the USGS Web site, www.usgs.gov/.

Representatives of affected fire departments and urban search and rescue provider agencies are among responders named to the multidisciplinary team.[3]

The ShakeOut Scenario originally was to be used as the basis for an exercise and to commemorate dual earthquake disasters: the 150-year anniversary of the 7.9 Fort Tejon quake, which ruptured the middle section of the San Andreas Fault in 1857 (when the sparse population and few buildings between Kern and Los Angeles counties prevented the kind of catastrophic loss that would occur in a similar quake today), and the 1933 Long Beach quake, which killed dozens including two firefighters; collapsed schools, fire stations, and many other municipal and private buildings; and spurred development of the world's first seismic safety buildings codes.

DARE TO PREPARE CAMPAIGN

The ShakeOut Scenario working group intended to implement a Southern Californiawide public education program leading up to a comprehensive exercise that would have all schoolchildren, public employees, hospital employees, and employees of participating private corporations and companies practice the officially recommended "duck, cover, and hold" and other safety procedures. This arm of the multiprong effort soon became known as the "Dare to Prepare" campaign. It had its own steering committee, which included several members from the original ShakeOut Scenario development team and steering committee.

The Dare to Prepare campaign (see www.daretoprepare.org) became a significant entity in itself. However, the reach of the program was greatly expanded when Los Angeles County (CA) Fire Department (LACoFD) Chief P. Michael Freeman directed that selected divisions of the Los Angeles County Fire Department located near the San Andreas Fault serve as prototype examples of fire service support for a massive public education effort to improve citizen readiness for earthquakes and other disasters. He encouraged other fire service leaders to do the same.

Another major effort to develop what is now known as the "Seven Steps to Earthquake Safety," part of the "Putting Down Roots in Earthquake Country" public education campaign (see www.earthquakecountry.info), which has input from firefighter/urban search and rescue (USAR) practitioners as well as earth and social scientists, is an example of the multidisciplinary approach that's proving so effective.

The Dare to Prepare effort has now taken hold to the extent that more than six million people are expected to participate in the Great Southern California ShakeOut to be held on November 13, 2008, beginning at 10:00 a.m., when the earthquake simulation will begin.

SHAKEOUT MERGES WITH OTHER EXERCISES

Exercising all levels of disaster response in a meaningful emergency response exercise requires additional coordination, funding, and support. Therefore, under the leadership of Dr.

Jones (member and former head of the state Seismic Safety Commission), the Great Southern California ShakeOut exercise merged with the state of California's annual Golden Guardian disaster response exercise and then incorporated the U.S. Military's Vigilant Shield federally mandated exercise in which the military supports civilian agencies during major disasters and catastrophes. The date for the ShakeOut exercise was then pushed back from March 2007 to November 2008.

The ShakeOut Steering Committee has been working with its Golden Guardian counterparts and the local fire/rescue agencies to coordinate with other planned or mandated disaster exercises. As a result of this collaboration, fire departments and other public safety agencies will be running their local disaster exercises on the same days. Regional US&R task forces recently implemented by California's Office of Emergency Services and based in major fire departments or groups of smaller departments will be deployed or otherwise exercising during this period. Also, some of the agencies that field state/federal Type I/Type III US&R task forces (the Federal Emergency Management Agency, for example) will be adjusting their exercise and practice deployment schedules to coincide with Golden Guardian. The combined ShakeOut/Golden Guardian 2008 is developing into a multitiered disaster response exercise that might even include elements of international response to exercise the "international assistance" annex of the new National Response Framework.

(4) Small fires normally handled by a single engine will grow to multiple buildings and, in some cases, become conflagrations.

Yet another innovative development attached to this exercise is the International Earthquake Conference, sponsored by the City of Los Angeles and now scheduled for November 12-14 (see www.iec.lacity.org).

SHAKEOUT STUDY REVEALS BIG SURPRISES

It's long been known that a 7.8 or larger earthquake on the southern San Andreas Fault would have devastating consequences, but the ShakeOut Study surprised many with its stark portrayal of a potential catastrophe unmatched in U.S. history.

Among the most sobering "surprises" anticipated by the ShakeOut Scenario are the following:

- Serious ground shaking will last up to three minutes in some of the most densely populated places in California. Some of the longest and most intense shaking will occur in downtown Los Angeles and the crowded L.A. Basin and San Gabriel Valley.
- Thousands of structures will totally or partially collapse.
- Up to eight high-rise buildings will collapse.
- Most of the major lifeline systems supplying water, electricity, fuel, food, and emergency aid to the multicounty impact area will be severed.
- Some dams will be on the verge of failure.
- The level of damage would far exceed that which occurred in New Orleans after Katrina. The region's economy would suffer long-term disruption and have a domino effect on the rest of the United States and eventually the world's economy.

"FIRE FOLLOWING EARTHQUAKE" STUDY

Perhaps the most sobering surprise for the fire service came from the "Fire Following Earthquake" study, which postulates that more than 133,000 structures could burn to the ground in firestorms and that unless the fire service can prevent or somehow limit the many potential conflagrations, the fire losses will *double* the damage and fatalities from the quake.

The scenario for the November 13, 2008, exercise is to be a day with average weather conditions and no Santa Ana winds. "The scenario should be realistic, not a worst-case one," notes Professor Charles Scawthorn in the "Fire Following Earthquake" report.[4] Among the questions Scawthorn says should be answered include the following:

- How will ignitions be reported after an earthquake?
- How will fire departments respond?
- How long will it take for the fires to be extinguished?
- What mutual-aid agreements are in place, and how will they be activated?
- How will damage to telecommunications, water supply, and roadway damage affect response?
- What, if any, effective mitigation actions undertaken elsewhere might be practical in Southern California?
- What are the limitations of the "Fire Following Earthquake" scenario? Is there any research that could be done that would provide a more realistic or perhaps more challenging or detailed scenario?

The Study report showed that most fire departments are not sized or equipped with sufficient "surge capacity" to cope with the fires following a major earthquake.

The report estimated that a hypothetical M7.8 earthquake (the modeled event) occurring at 10 a.m. on November 13 on the southern segment of the San Andreas Fault, resulting in MMI VI-VIII in the Los Angeles basin and accompanied by breezy, low-humidity conditions, would result in approximately 1,600 ignitions that would require the response of a fire engine (not including wildland and wildland urban interface fires). In the approximately 1,200 fires that the first responding engine would not be able to adequately contain, resulting conflagrations would destroy several city blocks in Riverside and San Bernardino counties. Of more concern, however, is that in portions of Orange County, and especially the central Los Angeles basin, dozens to hundreds of large fires are likely to merge into dozens of conflagrations, destroying tens of city blocks. There could also be one or several super conflagrations that destroy hundreds of city blocks.

The report notes that these fires could cause the loss of hundreds to perhaps a thousand lives and result in an economic loss of $40 billion to perhaps as much as $100 billion. It says mandatory automated gas shutoff valves or seismic shutoff meters in densely built areas may mitigate the problem.

The quake was modeled for a normal November day without Southern California's dreaded Santa Ana wind conditions to avoid a scenario that would quickly overwhelm all available resources and result in an unwinnable situation. Such a scenario would thwart the purpose of the exercise—to allow the public, the government, and emergency responders to test and evaluate current strategies and abilities to deal with the most likely San Andreas Fault scenario.

SEARCH AND RESCUE OPERATIONS

Among conditions in the scenario at the end of the first day of the exercise would be the following:

- Spontaneous groups of responders continue to work (though fatigue is depleting their ranks); locally based search and rescue teams are fully deployed; emergency operations centers are seeking assistance through the fire

Days 1 and 2: The ShakeOut Earthquake Scenario

Below are some key passages from the ShakeOut Earthquake Scenario circular that describe conditions for which responders must be prepared:

Thursday, November 13, 10:00 a.m. The quake begins. The San Andreas Fault suddenly awakens at Bombay Beach, northeast of the Salton Sea, and the rupture shoots northwest along the fault at two miles per second, sending seismic energy waves out in all directions. In an instant, the ground on the two sides of the fault is offset nearly 44 feet, changing the political and geographic boundary between Imperial and Riverside counties.

Thursday, 10:00:30 a.m. The earthquake's rupture front travels up the fault, sending out seismic waves that shake the ground, shifting emergency generators, overturning computers, cracking airport runways, and igniting fires. By now, the thick sediments of the Coachella Valley are resonating; the earthquake waves bounce between the rock walls of the valley's edges. Strong shaking will continue here for nearly a minute. Many older buildings suffer structural damage. Many older concrete buildings quickly collapse, trapping occupants. The rupture front continues its advance to San Gorgonio Pass and dismantles the 10 miles of Interstate 10 freeway that straddle the San Andreas Fault. The eastern part of Riverside County is now cut off from the western part.

Thursday, 10:01:00 a.m. Most people in Los Angeles and Ventura counties are not yet aware of what is happening as the earthquake pounds the Coachella Valley and heads their way, by now bending rail lines and derailing a train. Roads that previously were thoroughfares across the fault now end abruptly and pick up again 15 feet to the right. The strong shaking also sends landslides across the rails and roads. Pipelines snap, and electrical transmission lines fail. Spraying fuel ignites, causing an explosion. Strong shaking begins to reverberate in the sediment-filled basins of the Inland Empire. Old warehouse districts and historic downtowns are crumbling; many of their old, unretrofitted buildings have trapped or killed the people inside. Many older concrete buildings have collapsed, and many older wood-frame buildings have shifted off their foundations, breaking gas and water lines in the process. The Coachella Valley is still shaking.

Thursday, 10:01:30 a.m. Over geologic time, the motion of tectonic plates has pushed the mountains of southern California up, while fire, rain, and rivers have brought the mountains down, piece by piece, filling basins with sediment and creating low, flat areas. Like many cities, Los Angeles was built atop sediments. Some of the seismic waves now reach these sediments and find easy territory in which to move back and forth, shaking vigorously long after the waves fade elsewhere. Strong shaking will continue in Los Angeles for 55 seconds. Big, long seismic waves reverberate in the sedimentary basins. Many buildings ride them like boats in choppy seas, but some are not so resistant. The prolonged, strong shaking heavily damages and sometimes collapses hundreds of old brick buildings, hundreds of older commercial and industrial concrete buildings, many wood-frame buildings, and even a few fairly new high-rise steel buildings.

Thursday, 10:02 a.m. (two minutes after the quake began). At last, the fault has stopped rupturing, but seismic waves continue to advance into Bakersfield, Oxnard, and Santa Barbara—here the shaking is just beginning. Across Southern California, the power is out. Emergency generators that have been secured against earthquake shaking are still functional and now kick on. The shaking has finally stopped in the Coachella Valley, but the aftershocks are just beginning. Throughout Southern California, in the next few months, there will be tens of thousands of earthquake aftershocks large enough to feel. There will be dozens large enough to cause additional damage and to imperil victims and rescuers.

All over the region, a foreseeable tragedy unfolds. Buildings engineers knew were going to perform badly have performed badly. These are older buildings, constructed with little earthquake resistance. The experts have names for them—nonductile reinforced concrete, tilt-up concrete, unreinforced masonry, soft-stories. Thousands of other structures are still standing but are so gravely damaged that they can never be used again. While the earth still shakes in places far from the earthquake's origin, people in the earliest hit areas are beginning to confront damaged buildings and to help those who are trapped or hurt. Lacking gloves, crowbars, and training, some people claw through debris with bare hands. Ultimately, 95 percent of those who are rescued will be rescued by bystanders, family members, and local responders.

Friday, November 14, 03:17 a.m. (17+ hours after the quake began). A magnitude 7.2 aftershock begins near San Bernardino and ruptures west along the base of the San Gabriel Mountains. The rupture stops 18 miles east of Pasadena, near Monrovia. The location and size of this earthquake are devastating to the already-weakened infrastructure and overextended emergency response resources. The aftershock triggers damaging aftershocks of its own.

(5) Disruption of traffic routes, many simultaneous structure fires, ruptured water mains, and other factors will result in conflagration. (6) Fire departments that protect major wildland and urban areas may find conflicting demands for resources.

mutual-aid system, including the Emergency Management Assistance Compact (EMAC), the interstate mutual-aid pact; and national teams are mobilized by FEMA. In an event of this magnitude, international US&R teams will be requested to respond, and the military will play a very active role in supporting search and rescue operations. More than two decades of training tens of thousands of firefighters across the nation in collapse rescue will pay off during this event.

- Immediately after the earthquake, fires ignite at hundreds of locations; more fires continue to be reported, and this adversely affects search and rescue operations in many significant ways.
- Bridge closures, damage to freeways and surface streets, and debris in roadways have frustrated the timely and efficient deployment of search and rescue teams.
- Difficulties communicating between field units and emergency operations centers impair the ability of teams to accomplish search and rescue activities; road conditions and poor communications prevent successfully rescued critically injured patients from being rapidly transported to hospitals.
- Some search and rescue teams and spontaneous volunteers are forced by flames to leave the rescue scene, leaving those trapped in the debris to die if they cannot release them even with very extreme measures like field amputation. Secondary hazards—including an evacuation below a San Bernardino County dam that has been compromised by damage from the earthquake, several sites of hazardous materials releases, and a continuing series of large aftershocks—have also hampered search and rescue efforts.

WHAT IS BEING DONE

The November 13-18 ShakeOut Scenario/Dare to Prepare public education campaign/Golden Guardian 2008 disaster exercise, it is anticipated, will inform the public and responders about actions that can save lives and the vulnerable elements of the environment and property. Also, all levels of government (including military support of civilian responders) will have the opportunity to simulate their response to a mock multiday catastrophic-level disaster so they can assess the overall readiness of their disaster response and recovery systems and the level of individual readiness of the affected population. This information will be used to determine any needed changes and improvements, to help direct disaster readiness funding where it is most needed, and to make all users more familiar with disaster response protocols and capabilities. It's also intended to test the new National Response Framework established by the Department of Homeland Security following Hurricane Katrina.

The ShakeOut Scenario has already had several major effects. Because it is based on the most comprehensive study ever conducted on the San Andreas Fault's southern section and the likely consequences of a major rupture in this region of 20 million people, the reality of this event is starting to register with those responsible for planning emergency response; coordinating humanitarian aid and recovery; and ensuring functions such as the continuity of government, business, and public safety.

The California State Seismic Safety Commission is convening a panel of fire chiefs and subject matter experts, including L.A. County Fire Chief Freeman, former LAFD Chief Don Manning, Fire Chief Don Parker [formerly of the Vallejo (CA) Fire Department and now head of the Seismic Safety Commission], and others to examine the ShakeOut Scenario's "Fire Following Earthquake" problem and develop recommendations for limiting the evolution and spread of major simultaneous urban conflagrations and other fire-related problems. The Los

Angeles County and City Fire Departments are moving forward with working groups studying solutions for the vexing problems posed by a huge San Andreas Fault quake, and they are joining departments like those in Pasadena, Long Beach, LaHabra Heights, and San Bernadino as well as Orange, Ventura, San Diego, and Riverside counties in spearheading "new paradigm" solutions to the worst problems a San Andreas quake can cause. The Los Angeles area fire chiefs have taken a proactive stance on this issue; discussions are aimed at developing consensus on the most important strategic issues.

Clearly, the scenario envisioned by the ShakeOut will require the combined efforts of well-trained and properly equipped first responders, augmented by teams of citizens (Community Emergency Response Teams), backed by specialized US&R units and companies and highly trained regional, state, federal, and international US&R teams. The ShakeOut Earthquake Scenario will test those systems.

•••

This is a preliminary report on efforts to develop and use the ShakeOut Earthquake Scenario to test and improve our ability to manage catastrophic-level disasters. It lays out the stark picture of consequences that can be expected when the southern section of the San Andreas Fault inevitably ruptures and of the challenges that will confront firefighters and other responders.

The effectiveness of the exercise, the performance of our response systems, lessons learned, and recommendations will be reported after the November exercise. You can follow the progress of this effort by checking www.shakeout.org/, www.daretoprepare.org/, the USGS Web site, and the Web sites of the California Governor's Office of Emergency Services and the Department of Homeland Security/FEMA. ●

AUTHOR'S NOTE: This is a true story. After this was being prepared, on July 29, 2008, I was sitting in the Lakewood (CA) Civic Center, on the second floor. The time was 11:42 a.m. Gulfport (MS) Mayor Brent Warr was addressing 500 firefighters, police officers, scientists, and emergency managers at an earthquake disaster planning conference. He was describing his city's experience after being flattened by Hurricane Katrina and the search, rescue, and recovery operations that challenged every level of government.

In mid-speech, the speaker was caught by a sudden jolt: The floor buckled, and the steel-frame building swayed and rocked. Everyone in the room immediately understood that this was not part of the conference and that a significant earthquake was occurring. The disaster coordinator from one city automatically leapt to his feet and yelled, "Everybody duck and cover," as ceiling tiles fell and the overhead lighting system swayed. Many of the participants were already beneath the tables, having practiced the protective action known as "duck, cover, and hold on" many times for exactly this situation.

The initial shaking and the reverberations from the so-called "basin effect" (where the energy bounces between underground geological structures and, in some cases, prolongs the shaking) lasted long enough that structural damage or collapse was clearly a possibility somewhere in the affected area. Within moments, radio traffic was indicating that fire units were rolling out conducting their post-quake "windshield surveys" as per standard fire department protocols, looking for damaged buildings, fires, injured parties, hazardous materials releases, and other emergencies that would be triaged as they were encountered and tallied to determine where additional resources were needed most.

Emergency Operations Centers were going operational within the first half hour, although most reports indicated that the worst damage appeared to be the collapse of some structural walls, with no serious injuries and ultimately no fatalities. Southern California dodged another proverbial bullet, but this quake was also seen as a shot across the bow, a reminder of the ever-present threat of serious earthquakes that can occur at any moment without warning.

For the mayor of Gulfport, another layer had been added to his narrative on disaster planning, response, and recovery. For Southern Californians, it was *almost* business as usual in a place where the ground moves with disconcerting frequency. The 5.4 earthquake caused light to medium damage in some areas (broke windows, knocked some walls down, and caused varying levels of structural damage), but this was "only" a moderate earthquake. Everyone here knows that something much, much bigger is in the offing. They just don't know exactly when it will happen, and this is part of the constant dilemma for the fire departments and other emergency response agencies.

ENDNOTES

1. For many years, Jones was scientist-in-charge for USGS earthquake activities in Southern California. She served on the National Earthquake Program Council and coordinated all earthquake research in Southern California funded by the USGS.

2. More information on the science behind this project and the 250-plus page report is available in *The ShakeOut Scenario* (USGS Open-File Report 2008-1150; http://pubs.usgs.gov/of/2008/1150/).

3. As a member of a major stakeholder fire department, I have been working with the seismologists, engineers, nongovernmental organizations, and others involved with earthquake research, planning, mitigation, and response for more than 20 years as part of preparations for urban search and rescue hazard identification, mission profiling, planning, training, and response.

4. "A Note on Fire Following Earthquake for the Southern San Andreas Fault M 7.8 Earthquake (SoSAFE) Scenario," Charles Scawthorn, S.E. SPA Risk LLC, Berkeley CA 94708, for the United States Geological Survey, Pasadena CA, 14 February 2007.

ADDITIONAL REFERENCE

The ShakeOut Earthquake Scenario—A Story That Southern Californians Are Writing, U.S. Department of the Interior, Suzanne Perry, Dale Cox, Lucile Jones, Richard Bernknopf, James Goltz, Kenneth Hudnut, Dennis Mileti, Daniel Ponti, Keith Porter, Michael Reichle, Hope Seligson, Kimberley Shoaf, Jerry Treiman, and Anne Wein. U.S. Geological Survey Circular 1324. Jointly published as California Geological Survey Special Report 207.

● **LARRY COLLINS** is a 28-year veteran of and captain with the Los Angeles County (CA) Fire Department (LACoFD) and a USAR specialist and paramedic assigned to USAR Task Force 103, which responds to technical rescues and multialarm fires across the county. He is a Search Team manager for the LACoFD's FEMA/OFDA US&R Task Force for domestic and international response, and he has served as a US&R specialist on the "Red" FEMA US&R Incident Support Team since 1990. The author of dozens of articles and case studies, he wrote the textbook series *Technical Rescue Operation* (Fire Engineering: Vol.1, 2004; Vol. 2, 2005); the *Rescue* chapter of *The Fire Chiefs Handbook*; and the *Rescue* chapter of Fire Engineering's *Handbook for Firefighter I and II*.

The ShakeOut San Andreas Earthquake Scenario

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COURSE EXAMINATION

1. The San Andreas fault is approximately:
   a. 1,200 miles long
   b. 1,800 miles long
   c. 1,000 miles long
   d. 1,500 miles long

2. In order to better understand the potential consequences of a seismic event on the San Andreas fault, which agency commissioned a study in 2006?
   a. The Los Angeles County Fire Department
   b. The United States Geological Survey
   c. The San Francisco Office of Emergency Management
   d. The California Department of Forestry

3. What was the name of the scenario that was developed?
   a. The ShakeUp Scenario
   b. The ShakeDown Exercise
   c. The ShakeOut Scenario
   d. The ShakeUp Exercise

4. What public education effort was developed so as to involve schoolchildren and citizens?
   a. "Dare to Plan"
   b. "Dare to Prepare"
   c. "Dare to Care"
   d. "Dare to Scare"

5. How many fires would be ignited in the Los Angeles basin as a result of the earthquake?
   a. 1,600
   b. 1,500
   c. 1,800
   d. 2,000

6. How much in property damage *due to fires* could be expected from the projected earthquake?
   a. $20 - 40 billion
   b. $25 – 50 billion
   c. $25 – 60 billion
   d. $40 – 100 billion

7. The interstate mutual aid compact is known as:
   a. EMAC
   b. FEMA
   c. MUNA
   d. LUNA

8. In order to deal with gas-fed fires igniting as result of the earthquake, it was suggested that it be mandated to provide what kind of equipment?
   a. automated block valves
   b. quick response sprinklers
   c. breakaway gas meters
   d. automated gas shutoff valves

9. Up to how many high-rises were expected to collapse in the scenario?
   a. 8
   b. 12
   c. 15
   d. 25

10. How many structures might burn to the ground according to the "Fire Following Earthquake" report?
    a. 25,000
    b. 40,000
    c. 50,000
    d. 133,000

11. California conducts an annual disaster response exercise know as:
    a. "The California Big One"
    b. "The Golden Guardian"
    c. "North-South California Annual Drill"
    d. "The West Coast Grand Exercise"

12. "The Great Shakeout" was held on:
    a. October 20th, 2008
    b. November 1st, 2008
    c. November 13, 2008
    d. September 15th, 2008

The ShakeOut San Andreas Earthquake Scenario

13. How many people, live in the region covered by the scenario?

a. 10 million
b. 20 million
c. 25 million
d. 30 million

14. What change to the scenario would have created an "unwinnable" situation, according to the author?

a. A tsunami
b. Santa Ana winds
c. Heavy rains
d. A freak snowstorm

15. At the national level, the scenario was intended to test the"

a. National Response Framework
b. NIMS
c. ICS
d. FEMA

16. In addition to the military, what other organizations would be requested to Respond?

a. Nevada fire departments
b. East coast forest firefighters
c. Mexican police forces
d. International USAR teams

17. Where was the 1857 San Andreas earthquake centered?

a. San Francisco
b. Sacramento
c. Fort Tejon
d. San Diego

18. How long was the rupture in the scenario?

a. 300 feet
b. 1,000 feet
c. 1,200 feet
d. 1,500 feet

19. CERT stands for"

a. Citizen Emergency Reporting Tweeter
b. Community Emergency Response Team
c. Crowd Emergent Rapid Task Force
d. City Emergency Response Tablet

20. Where was the area that was evacuated below a dam on the first day?

a. San Diego County
b. San Fernando Valley
c. Los Angles County
d. San Bernardino County

Notes

The ShakeOut San Andreas Earthquake Scenario

PROGRAM COMPLETION INFORMATION

If you wish to purchase and complete this activity traditionally (mail or fax) rather than Online, you must provide the information requested below. Please be sure to select your answers carefully and complete the evaluation information. To receive credit, you must answer at least six of the eight questions correctly.

Complete online at: www.FireEngineeringUniversity.com

PERSONAL CERTIFICATION INFORMATION:

Last Name (PLEASE PRINT CLEARLY OR TYPE)

First Name

Profession/Credentials License Number

Street Address

Suite or Apartment Number

City/State Zip Code

Daytime Telephone Number with Area Code

Fax Number with Area Code

E-mail Address

TRADITIONAL COMPLETION INFORMATION:

Mail or fax completed answer sheet to
Fire Engineering University, Attn: Carroll Hull,
1421 S. Sheridan Road, Tulsa OK 74112
Fax: (918) 831-9804

PAYMENT & CREDIT INFORMATION

Examination Fee: $25.00 Credit Hours: 4

Should you have additional questions, please contact Pete Prochilo (973) 251-5053 (Mon-Fri 9:00 am-5:00 pm EST).

❑ I have enclosed a check or money order.

❑ I am using a credit card.

My Credit Card information is provided below.

❑ American Express ❑ Visa ❑ MC ❑ Discover

Please provide the following (please print clearly):

Exact Name on Credit Card

Credit Card # Expiration Date

Signature

ANSWER FORM

Please check the correct box for each question below.

1.	❑ A	❑ B	❑ C	❑ D	11.	❑ A	❑ B	❑ C	❑ D
2.	❑ A	❑ B	❑ C	❑ D	12.	❑ A	❑ B	❑ C	❑ D
3.	❑ A	❑ B	❑ C	❑ D	13.	❑ A	❑ B	❑ C	❑ D
4.	❑ A	❑ B	❑ C	❑ D	14.	❑ A	❑ B	❑ C	❑ D
5.	❑ A	❑ B	❑ C	❑ D	15.	❑ A	❑ B	❑ C	❑ D
6.	❑ A	❑ B	❑ C	❑ D	16.	❑ A	❑ B	❑ C	❑ D
7.	❑ A	❑ B	❑ C	❑ D	17.	❑ A	❑ B	❑ C	❑ D
8.	❑ A	❑ B	❑ C	❑ D	18.	❑ A	❑ B	❑ C	❑ D
9.	❑ A	❑ B	❑ C	❑ D	19.	❑ A	❑ B	❑ C	❑ D
10.	❑ A	❑ B	❑ C	❑ D	20.	❑ A	❑ B	❑ C	❑ D

COURSE EVALUATION

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 1.

1. To what extent were the course objectives accomplished overall?	5	4	3	2	1
2. Please rate your personal mastery of the course objectives.	5	4	3	2	1
3. How would you rate the objectives and educational methods?	5	4	3	2	1
4. How do you rate the author's grasp of the topic?	5	4	3	2	1
5. Please rate the instructor's effectiveness.	5	4	3	2	1
6. Was the overall administration of the course effective?	5	4	3	2	1
7. Do you feel that the references were adequate?		Yes		No	
8. Would you participate in a similar program on a different topic?		Yes		No	

9. If any of the continuing education questions were unclear or ambiguous, please list them.

10. Was there any subject matter you found confusing? Please describe.

11. What additional continuing education topics would you like to see?

PLEASE PHOTOCOPY ANSWER SHEET FOR ADDITIONAL PARTICIPANTS.

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We encourage participant feedback pertaining to all courses. Please be sure to complete the survey included with the course. Please e-mail all questions to: Pete Prochilo, peterp@pennwell.com.

INSTRUCTIONS
All questions should have only one answer. Grading of this examination is done manually. Participants will receive confirmation of passing by receipt of a verification form.

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Completing a single continuing education course does not provide enough information to give the participant the feeling that s/he is an expert in the field related to the course topic. It is a combination of many educational courses and clinical experience that allows the participant to develop skills and expertise.

COURSE CREDITS/COST
All participants scoring at least 70% on the examination will receive a verification form verifying 4 CE credits. Participants are urged to contact their state or local authority for continuing education requirements.

RECORD KEEPING
PennWell maintains records of your successful completion of any exam. Please go to www.FireEngineeringUniversity.com to see your continuing education credits report.