



State Of California

ALFRED E. ALQUIST  
SEISMIC SAFETY COMMISSION



*Arnold Schwarzenegger, Governor*

September 28, 2010

To Whom It May Concern:

This letter is to introduce Prof. Charles Scawthorn who, in cooperation with the Pacific Earthquake Engineering Center, is currently engaged in a study for the Seismic Safety Commission entitled *Water Supply in Regard to Fire Following Earthquake*. The purpose of the project is to qualitatively review the current status of emergency water supply in California as a result of a fire following earthquake and provide a series of recommendations for improvements if/where needed. Any assistance you can provide to Prof. Scawthorn in performing this study will be greatly appreciated and contribute to reducing earthquake and fire losses in California.

Yours truly,

A handwritten signature in black ink, appearing to read "R. McCarthy".

Richard McCarthy  
Executive Director

**State of California  
Seismic Safety Commission**

**Memo**

**To:** Commissioners

**From:** Richard McCarthy  
Seismic Safety Commission  
1755 Creekside Oaks Drive, Suite 100  
Sacramento, CA 95833  
(916) 263-5506

**Date:** 6/2/10

**Subject:** **Fire Following Earthquake Report**

**Background**

At the May meeting, the Commission reviewed and commented on a draft concept paper for a "Fire Following Earthquake" white paper. This project will be supported by funding from the Commission's Research Program.

The following describes the project, costs, and estimated timeline for completion:

*Concept Note for development of a CSSC White Paper*

**Water Supply in regard to Fire Following Earthquake**

Fire following earthquake (FFE) is a significant problem in California. Historically, every significant earthquake in California has resulted in multiple simultaneous fires that have strained, and at least in 1906, overwhelmed the fire service. In both the 1971 San Fernando and the 1994 Northridge earthquake, there were over 100 ignitions. Other disasters clearly demonstrate that massive fires are a problem in California under even non-earthquake ignitions, when only one or a few ignitions are involved - the numerous wildland urban interface fires that occur in California almost every year are only the most telling example of this<sup>1</sup> - another example is the 1988 First Interstate Bank Fire, which totally destroyed 4 floors of the state's tallest building (at that

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<sup>1</sup> OES (2008) *California Fire Siege 2007 - An Overview*. pp. 110pp. California Governor's Office of Emergency Services, together with California Department of Forestry and Fire Protection and the US Forestry Service, Sacramento.

time) and severely damaged the rest of the building through water and smoke damage.

In the absence of a major recent earthquake affecting the urban centers of California, the 2008 ShakeOut<sup>2</sup> and associated Golden Guardian Exercise examined potential fires assuming a Mw 7.8 event on a morning in mid-November, with breezy, low humidity conditions. The analysis found that approximately 1,600 ignitions occur in Southern California, with the central Los Angeles basin experiencing hundreds of large fires. The estimated loss was estimated to be hundreds to perhaps a thousand lives, and approximately 200 million sq. ft. of residential and commercial building floor area, worth perhaps as much as one hundred billion dollars and virtually all insured.

While the fire service in California since 1906 has professionalized and advanced technologically to the point of being perhaps the best in the world, it has not been tested by a major earthquake since 1906. And, the Achilles Heel in 1906 was not the fire service itself, but rather the failure of the water supply - without water, firefighters may be able to save some lives but are handicapped to the point of helplessness for putting out fires. Water systems in California have failed in virtually all urban earthquakes in California - not only 1906, but also in the San Fernando, Northridge and the 1989 Loma Prieta events. As a result of these more modern events, water departments have engaged in major reviews of their system's seismic vulnerability, and spend hundreds of millions of dollars retrofitting their systems. Exemplary programs include LADWP and MWD in Southern California, and EMBUD and San Francisco's Hetch Hetchy system in Northern California, to name a few of the larger programs.

Nevertheless, the Achilles Heel of these systems, and the entire fire following earthquake problem, remains the distribution system - despite massive seismic retrofit programs, it has not been possible to replace all of the distribution systems, and it is quite possible that numerous distribution breaks will occur in the high intensity areas of a major earthquake, which will also be the areas most likely to have many fires. These breaks will not cause system-wide loss of water, but will cause loss of water in the neighborhood of the fire - for the firefighter, effectively

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<sup>2</sup> Jones, L. M., Bernknopf, R., Cox, D., Goltz, J., Hudnut, K., Mileti, D., Perry, S., Ponti, D., Porter, K., Reichle, M., Seligson, H., Shoaf, K., Treiman, J. & Wein, A. (2008) *The ShakeOut Scenario*. pp. 312pp. USGS Open File Report 2008-1150, U.S. Geologic Survey, Reston, VA.

the same thing. Knowing this, fire departments have identified and developed plans to access alternative water sources - in most cities for example, these include swimming pools, tanks, creeks, ponds and stormwater drains. San Francisco, due to its experience in 1906, has gone far beyond this, to develop and maintain the high pressure seawater-supplied Auxiliary Water Supply System (AWSS) and over 170 cisterns (underground water tanks spread throughout the city). In fact, San Francisco has a \$412 million bond issue on the June 2010 ballot to enhance this system. However, other cities, particularly Los Angeles, San Jose and San Diego, lack such systems and, quite worryingly, the capacity of their water supplies (normal, and alternative) have never been examined vis-à-vis the demands that multiple simultaneous post-earthquake fires will place on those supplies.

In order to examine this issue, the Seismic Safety Commission will commission a study and White Paper on the subject of *Water Supply in Regard to Fire Following Earthquake*. The outline of the study is:

1. Introduction

- a. Brief review of fires following earthquakes in California, and elsewhere (to extent relevant)
- b. Importance of water in re fire following earthquake
- c. Purpose

*The purpose of the paper is to qualitatively review the current status of emergency water supply in California vis-à-vis fire following earthquake, and provide a series of recommendations for improvements if/where needed. While some recommendations will be possible given information in hand, recommendations for some other potential improvements (while probably needed) won't be possible to make given current information, so that a final recommendation will be an outline of necessary research.*

The focus of the paper will be on fire following earthquake in urban areas (including the special problem of tall buildings). Low density communities and non-earthquake fires (e.g., the urban wildland interface fire problem) will not be treated except insofar as relevant to the fire following earthquake problem.

2. Current status of California's urban water systems vis-à-vis fire following earthquake

3. Current status of California's urban fire departments emergency water supply and fire following earthquake
4. Tall buildings
5. Opportunities to enhance emergency water supply vis-a-vis fire following earthquake
6. Summary and Recommendations

The study will be conducted by the Pacific Earthquake Engineering Center (PEER, headquartered at the University of California, Berkeley) under the supervision of Prof. Stephen Mahin (Director of PEER) and with the lead researcher being Prof. Charles Scawthorn, a Visiting Scholar at PEER. The study is expected to be of three to six months duration, and cost approximately \$49,000.

#### Recommendation

Staff recommends that the Commission review and approve this project as proposed and outlined above. Commissioner Stevens will oversee this project on behalf of the Commission.