

State of California  
Seismic Safety Commission

Memo

To: Commissioners

From: Robert Anderson, P.G., C.E.G.  
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Date: September 30, 2014

Subject: National Aeronautics and Space Administration/Jet  
Propulsion Laboratory Capabilities and California  
Earthquake Resiliency (Phase 1 Proposal)

Representatives from the CSSC, the State and Consumer Services Agency and the Jet Propulsion Laboratory/NASA (JPL/NASA) have held several discussions examining JPL/NASA products that may be used in emergency response and recovery. The CSSC has asked JPL/NASA to propose a pilot project where three major topics would identify useable detection and damage assessment tools.

The first detection tool is for looking for victims trapped in rubble. The prototype unit is called: Finding Individuals for Disaster and Emergency Response (FINDER). This is essentially a portable low level microwave transponder. The FINDER technology would be used to help determine the location of persons trapped in rubble or at sites that have suffered severe damage. (Please see the attached proposal for a description of how FINDER technology may be further developed.

A second proposed activity is the development of satellite imaged damage assessment tools that can be used with minor training by emergency managers and local officials. This technology has been successfully used by the JPL/NASA personnel in earthquake damage assessment in concert with more conventional damage assessment techniques, including the El Mayor Cucupah and the South Napa earthquakes in California.

The third activity would be the development of Unmanned Aerial Vehicle Synthetic Aperture Radar (UAVSAR) data products that can be used by local emergency responders (such as city, special district or jurisdiction and County) as well as state officials such as OES and DWR). This activity would focus on working with local and state officials to develop product identifying faults and earthquake related changes to the Delta and adjacent areas based on radar imaged deformation maps. This information could be used in conjunction with loss estimation models.

**Recommendation:**

Commissioners are encouraged to ask questions, and approve the attached proposal for funding.



## **Jet Propulsion Laboratory Earthquake Resiliency Project** **Pilot Project/Phase 1**

### **The Need**

Situational awareness following an earthquake or other natural disaster is critical for state, county and local officials to know how to respond. Understanding the scope of damage, identifying where critical infrastructure is compromised and where it is still working is necessary for getting needed supplies to locations where people are at risk in the most efficient way possible. The Jet Propulsion Laboratory (JPL) has expertise in developing state of the art technology and airborne and satellite imaging capabilities that can be applied to emergency response and provide information that complements or was unavailable by traditional methods. JPL has responded to the M6.0 South Napa event with several different imaging techniques that could be helpful for earthquake response. JPL will partner with the Seismic Safety Commission on a report assessing how JPL's technical capabilities, including the observations made for the South Napa earthquake, can be most useful for improving the state's resiliency following an earthquake or other natural disaster.

### **JPL Background**

JPL is a federally funded research and development facility managed by the California Institute of Technology for the National Aeronautics and Space Administration. Since the late 1970s, JPL engineers and scientists realized that the sensors they were developing for interplanetary missions could be turned upon Earth itself to better understand our home planet. This has led to a series of highly successful Earth monitoring missions that have evolved into a major segment of the Laboratory's activities, now sponsored by NASA's Science Mission Directorate. Currently, JPL's Earth observing projects include 5 spacecraft, 9 space instruments and 25 airborne instruments.

In the decades it has led the nation's planetary exploration program, JPL has honed several skills and areas of innovation, including digital image processing, imaging systems, intelligent automated systems, instrument technology, microelectronics and more. Many of these disciplines found applications outside the planetary spacecraft field, from solar energy to medical imagery. The Laboratory has also applied space-based operational, communication and information processing techniques to the needs of the Department of Defense, Federal Aviation Administration and other federal agencies. Its active technology transfer program with the industrial community dates back to the early days of the missile program. JPL conducts technology development projects both for NASA and for sponsors other than NASA.

### **Proposal Summary**

Jet Propulsion Laboratory seeks a partnership with the Alfred E. Alquist Seismic Safety Commission (SSC), which advises state elected leaders on ways to reduce earthquake risk based on expert research. JPL proposes to work with the SSC to develop technological capability and imaging capability with the specific objective of

helping California communities and businesses mitigate loss and speed recovery in the event of serious natural disasters, including but not limited to earthquakes.

JPL proposes to achieve these objectives by working with the SSC on a report, assessing the M6.0 August 24, 2014 South Napa earthquake response products and other relevant JPL technical capabilities. They will work with the SSC to explore capabilities, response protocols, and information products that will be useful to different constituencies within the state following an earthquake. JPL has several projects that have already been developed for emergency response and infrastructure monitoring, several of which were used in response to the South Napa earthquake. In this pilot project JPL scientists and technicians will work with state and county level agencies to determine what their specific needs are for response and recovery, using the South Napa earthquake as a case study on how JPL can contribute.

The project will result a report, written by JPL in partnership with the Seismic Safety Commission, with specific recommendations for how JPL's capabilities can best be utilized to help the state's earthquake response and recovery, using the M6.0 South Napa earthquake as a case study.

The first phase of the proposed partnership would investigate the following:

1. Development and application of the prototype technology Finding Individuals for Disaster and Emergency Response (FINDER) for helping to locate individuals trapped in collapsed structures following an earthquake. The prototype has been demonstrated and successfully tested by the Fairfax, Virginia Urban Search & Rescue Team at their training facility in Lorton, VA. It can locate individuals buried as deep as 30 feet (about 9 meters) in crushed materials, hidden behind 20 feet (about 6 meters) of solid concrete, and from a distance of 100 feet (about 30 meters) in open spaces. JPL project managers and technologists would work with state emergency services and urban search & rescue teams to determine how best to put this technology in the hands of search and rescue teams, and will discuss how close the technology is to being commercialized.

2. Development of satellite damage assessment data products for determining where damage has occurred on a regional and individual-building scale following an earthquake or other natural disaster. JPL has expertise in using satellite radar to image collapsed buildings, flooded areas, landslides, and areas affected by liquefaction. JPL scientists can use the same satellite radar to image where faults have ruptured, offsetting roads and other potentially other critical infrastructure such as aqueducts or railways. In response to the South Napa earthquake, JPL generated a damage assessment map with satellite radar data. Ground validation of damage will provide excellent feedback to researchers and users on how this technology can best be applied for rapid damage assessment. JPL researchers and managers would work with the SSC and their partners to develop actionable data products from satellite radar sources.

3. Development of airborne imaging and damage assessment using UAVSAR. JPL scientists have used airborne imaging to study fault zones in California and assess the health of the levee system in the Sacramento-San Joaquin Delta. This Delta is the most critical water resource in California, supplying water to ~2/3 of its residents and to almost all of the agriculture of the Central Valley. This project, which is a collaboration between JPL, California Dept. of Water Resources, and USGS, has shown the utility of using airborne remote sensing to monitor the levees, augmenting ground-based and visual surveys in several ways, including detecting subtle change and providing regular observations with consistent methods and complete spatial coverage of the area. Presentations to many groups, including all agencies involved in emergency response in the Delta through the Delta County Coalition (a consortium of Contra Costa, Sacramento, San Joaquin, Solano and Yolo counties), have brought the radar remote sensing monitoring capability to the awareness of the community. Airborne observations can also provide spatially comprehensive, high-resolution imagery of deformation and damage in urban and rural areas following even relatively small earthquakes that cause damage to water mains, roads and houses. UAVSAR data was collected within a week after the South Napa earthquake, providing many high-resolution images of the deformation from that event. JPL researchers and managers would work with the SSC and their partners to develop actionable data products from airborne instruments in order to prepare first responders to use the radar remote sensing capability in advance of a major emergency.

#### **Period of Performance**

Six months, with target start date of November 2014 and completion date of April 2015

#### **Budget Summary**

The amount requested is not exceed \$50,000. Indirect costs (overhead) are not to exceed 25%. The funding will be used to cover costs associated with producing reports, including but not limited to: researchers and project manager salaries and benefits and travel costs.

Estimated costs per budget category:

Salary for researchers and project managers: \$32,990

Travel costs: \$4,000

Misc: \$500

Indirect/overhead: not to exceed \$12,500

Total: \$49,990



**LP25 Public Policy Symposium:  
Building Bay Area Resilience**

**October 16, 2014**

**9A—5P**

**Kaiser Center Auditorium**

**Oakland, CA**

**On October 17, 1989, at 5:08 pm., a magnitude 6.9 earthquake occurred in the Santa Cruz Mountains along the San Andreas fault. The earthquake caused 63 deaths, 3,757 injuries, and \$6 billion in property damage. It was the largest earthquake to occur in Northern California since the great San Francisco earthquake of 1906.**

Local jurisdictions, states, federal and regional agencies will be invited to attend the public policy symposium to commemorate the 25<sup>th</sup> anniversary of the Loma Prieta earthquake. Scheduled for Thursday, October 16, 2014, this symposium presents a critical opportunity to highlight the strengthening of Bay Area communities, lifeline systems and policies since the earthquake. Conference sponsors hope to inspire resilience action and spur the work required to make Bay Area cities and communities even more resilient to future disruptions.

Local, state, and national elected officials will be featured participants and will speak in panel sessions along with experts in public policy, engineering, mitigation, and resilience. Regional media partners and community advocates will join in on panel discussions and focus on recommendations for community resilience building for future regional earthquakes.

The Association of Bay Area Governments (ABAG), the California Earthquake Authority (CEA), the United States Geological Survey (USGS), the California Geological Survey (CGS), the Structural Engineering Association of California (SEAOC), the U.C. Berkeley Pacific Earthquake Engineering Center and the Structural Engineering Association of Northern California (SEAONC), along with other partner agencies, are convening regional, state and federal partners to build an advocacy alliance to ensure state-wide application of resilience polices and local implementation initiatives.

The commemoration of the 1989 Loma Prieta Earthquake in October 2014 will be the launch point for a three-year public policy program to improve both state and local laws that address community safety and resilience. Building from the January 2014 conference on the 1994 Northridge Earthquake, Bay Area stakeholders will promote a legislative program to update building codes to incorporate performance-based standards; call for safety programs to improve soft story and non-ductile concrete buildings; and, develop financial incentive programs to spark mitigation improvements.

The LP25 Planning Committee has crafted a conference agenda with informative sessions on how to promote multi-disciplinary and effective resilience planning and policy action. The conference committee will invite speakers—policy experts, community leaders and elected officials—to examine resilience progress accomplished in the last twenty-five years; discuss infrastructure interdependence; review best ways to finance community safety; and how cities apply implementation for a safer, smart future.