



**USING A SCENARIO TO TEST RESPONSE
TO A CATASTROPHIC URBAN EARTHQUAKE: GOLDEN GUARDIAN
EXERCISE '06 -- A REGION WIDE EMERGENCY RESPONSE EXERCISE**

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ABSTRACT

Responding to a catastrophic urban earthquake poses many challenges, including assessing the amount and extent of damage; understanding the interdependence of response and relief; staffing local, regional and state response organizations, setting priorities for critical resources; and managing regional, state and federal resource allocation. In November 2006, in partnership with the City of San Francisco, California Office of Homeland Security (OHS), the Federal Emergency Management Agency (FEMA) and the Governor's Office of Emergency Services (OES), OHS designed and executed a region wide disaster response exercise to test communication and coordination among 6 counties, state agencies, the federal government and supporting private entities -- representing more than 5 million residents. This exercise was the largest response exercise carried out in California in more than 20 years, and the first to be played out in real time.

The exercise started at 5:12 AM in the morning, requiring activations and redirection of staff as would actually occur in a rapid onset disaster event. Exercise "play" continued for 36 continuous hours, testing both administrative and organizational capabilities, as well as disaster response and management capabilities. More than 200 state and federal agency staff were activated and participated over three 12 hour shifts in local, regional and state operations centers. As in a real event, information about damage, losses and disruption was generated at the local level and then communicated, along with resource requests, from the local level to the state, requiring analysis, processing and priority setting.

This paper will describe the development of the scenario, the management of the scenario inputs to the exercise, the Federal response, challenges in assessing damage, allocating resources, communications and gaps in emergency management systems and capabilities.

Concept of Catastrophic Disaster Response Exercise

Preparing to respond to rapid onset catastrophic disasters provides unique challenges to emergency managers, requiring tactics and strategy that differ from those applied to day to day (normal) emergency operations. While normal operations of police, fire and health services agencies are exercised by frequent incidents, such as fires, moderate earthquakes, annual flooding; catastrophic disasters are infrequent, overwhelming, result in severe shortages of resources, require organizing and staffing for operations sustained for weeks to

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months, assignment of personnel who train infrequently, from allied, but not emergency management functions to disaster operational functions, and levels of stress that severely impact performance. In addition, information systems designed to support emergency operations frequently are inadequate to support the complexity and volume of demands. In addition, by definition, catastrophic disaster response is defined as response to events that overwhelm the normal capacity to respond, requiring implementation of priority setting systems for scarce resources, triage of actions, and strategic decision-making that few operational emergency managers are trained implement.

Rapid onset events, such as earthquakes, urban fires, and terrorist acts, complicate response and training by requiring rapid mobilization (ramping up response from a 'cold start') assessment and response with limited information and a high level of uncertainty, and a requirement to be making strategic decisions on actions to be taken and the allocation of resources without adequate information. The military describes the uncertainty of situation awareness as response in the "fog of war." A catastrophic disaster creates an environment similar to the chaos and confusion of battle.

Unfortunately, design of exercises for training and testing catastrophic response are usually constrained by costs, limited commitment of personnel from non-emergency response agencies, and an aversion to the disruption of normal government operations that result from simulating actual catastrophic disaster response impacts. For example, training and exercises are usually designed for single functions (fire fighting, flood fighting) and do not include care and shelter, medical response, transportation restoration, interim and long term housing replacement; or, the complex interrelationships that occur when many such functions are simultaneously engaged, competing for communications, information, transportation and personnel resources.

The Exercise Design

In the aftermath of the September 11, 2001 attacks, emergency managers at the local, state and federal levels in the United States focused almost entirely on planning for and responding to potential weapons of mass destruction and terrorist (WMD/T) attacks. Funding from the national government supported a narrowly defined WMD/T threat and training was narrowly defined. Hurricane Katrina (2005) changed the perspective and priorities for response training in California.

Funding for the scenario and exercise was provided by the California Office of Homeland Security and the Federal Emergency Management Agency as part of an annual regional preparedness exercise program -- Golden Guardian 2006 (GGEX06). The exercise was conceived and implemented by a multi-agency design team and consultants that included the following technical support and agencies.

- Nineteen counties impacted by the 1906 earthquake participated in the design and 6 counties, including San Francisco, San Mateo, Santa Clara, Alameda, Contra Costa and Marin participated in the exercise.
- The United States Geological Survey developed the ground motions and time history for ground shaking.
- The California Office of State-wide Health Planning and Development provided assessments of the performance of hospitals in the region

- The California Department of Transportation provided a narrative on potential damage to the freeway infrastructure
- Pacific Gas & Electric Company provided a narrative and time history of damage to the utility grid
- Bay Area Regional Transit District (BART) provided a narrative on damage to the rail transit system, including trans-bay tube.
- Technical support in developing the scenario and estimates of loss and damage were provided using HAZUS-MH and supported by PBS&J, Atlanta, Hope Seligson, and Charles Kircher & Associates.

Objectives of the Exercise Scenario

Catastrophic earthquakes pose unique challenges to emergency managers. Their onset is instantaneous, there are no warnings, they are regional, impacting large areas (urban regions) they result in extensive damage, deaths, critical injuries, with simultaneous degrading of communications, transportation, medical, fire suppression systems; and loss of housing and business infrastructure. To test California's capacity to respond to such an event, planners in the Governor's Office of Emergency Services (OES) used the opportunity of the 100th anniversary of the 1906 San Francisco earthquake to exercise response to a recurrence of that event as part of the state's annual exercise program: Golden Guardian. Funding and support for developing and executing the training and exercise was provided by the Federal Department of Homeland Security, the Federal Emergency Management Agency, the state's Office of Homeland Security, California OES and local governments of the San Francisco Bay Region. The Goal of the exercise was to test response in as realistic environment as could be simulated. Objectives included:

- To test and exercise staffing state and regional response from a 'cold start', including the delays in response capacity that are inherent in an event that occurred at 5:12 AM.
- To test the communication and coordination of response between local governments, the State of California Office of Emergency Services; and between the State and the Federal Emergency Management Agency.
- To use loss estimation modeling tools (ShakeMap [1], HAZUS [2]) to expedite strategic decision-making at the federal, state and regional levels prior to the acquisition of 'ground truth' intelligence .
- To exercise California's Standardized Emergency Management System (SEMS) Response Information Management System (RIMS) and situation reporting and resource requests from the Operational Areas (counties) to the Region, to the State and from the State to the Federal Government through FEMA.
- To develop and test procedures for establishing priorities for the allocation of scarce resources.
- Test procedures for establishing operational capability, transitioning into operations and sustaining operations over a 36 hour period.

Exercise play was divided into three phases: Hour 0 to hour 12). Creating the capacity to respond (staffing EOCs, modeling losses and estimating impact, assessing event impact); Hour 12 to hour 24). Responding to the surge of requests for resources (setting priorities for scarce resources, intelligence gathering and analysis, stabilizing response operations; and, Hour 24 to hour 36) Implementing a plan for sustained operations.

Unique Characteristics of the Scenario and Exercise

The majority of scenarios and emergency response exercises are designed to produce a static end state and test decision making in a controlled environment. Unfortunately, this approach does not replicate the environment of sudden onset disasters or simulate the actual time history of staffing, information acquisition, decision making or sustaining operations. Therefore, in order to provide more accurately replicate and train for the disaster environment, the scenario was structured on a realistic time history of infrastructure response, information acquisition, staffing and inter-governmental engagement. These parameters recognized that neither a disaster or a simulation is an end state picture; that information and the quality of decision making varies with time; that there is never adequate information for decision making; and that effective emergency management needs to train as they will have to play in a real event.

The scenario and exercise provided the following parameters:

- The scenario replicated the 1906 earthquake impacting 19 urban counties in central California
- It was a sudden onset event
- It was initiated from a ‘cold start’, necessitating the ramping up of staffing and response in real time
- The scenario replicated actual information flow from Local Governments to Regional agencies, to the state Operations Center and finally to the Federal response agencies
- As in a real event, loss estimation tools such as ShakeMap and HAZUS were used to provide an initial assessment of damage and guide initial response from state and federal agencies

Designing the Scenario and the Exercise

Exercise design and management was provided by a team from the California Office of Homeland Security and additional staff from OES and the participating counties. The ground motions for a recurrence of the catastrophic 1906 San Francisco earthquake (Mw 7.9) were provided by the United States Geological Survey (USGS) [2]. The USGS also provided simulated public information messages, and after shock probabilities and advisories. The West Coast / Alaska Tsunami Warning Center (WCATWC) provided messages and maps simulating a Tsunami Warning that would accompany the earthquake, for use during exercise play. Each county was provided with a detailed HAZUS [3] estimate of damage to critical facilities and transportation systems, fatalities, injuries requiring hospitalization, displaced households and shelter demand, and fire ignitions; along with maps depicting the spatial distribution of damage and losses [4]. County level teams then prepared more than 3,000 individual messages (injects) that would be used to simulate reports of damage. Over the year prior to the exercise, training was provided at the local, regional and state levels on the use of information systems, analysis and decision making, and priority setting for critical resources.

Exercise Observations

An hour prior to the scheduled exercise start, an actual Tsunami Warning was issued for the coast of California, resulting in a statewide notification and activation of local, state and federal operations centers. Exercise play was delayed and the earthquake was *rescheduled* to occur at 0600. Operations Centers were activated and staff notifications and assignments were made in ‘real time.’ While the State Operations Center (SOC) and the Coastal Region Operations Center (REOC) were operational for the Tsunami Warning two hours earlier, neither facility had an adequate complement of trained staff initially to respond to the

simulated earthquake. Notification and transportation of personnel (simulated as it would actually occur) resulted in staff arriving at the REOC and SCO between one and five hours after the event onset. Frequently, early arriving staff had not participated in training or were not trained to address the tasks in the early analysis and response phase. A critical mass of staffing was finally achieved seven hours after the event onset, at which time, the management of the regional response was handed over from the SOC to the REOC. The task of ‘catching up with the information flow’ was finally completed by EQ+12 hours. At EQ+14, the REOC and SOC were fully operational and planning, situation reporting, shift change briefings and a change in staff occurred.

From EQ+14 through the remainder of exercise play at EQ+36, response processes were stable, and were able to adapt to aftershocks, disruptions in communications and simulated media and politician’s demands.

Conclusions and Lessons

The lessons of GGEX 06 have created numerous challenges to emergency planners in California and at FEMA. Playing the exercise in real time identified the following gaps in response capability and spurious assumptions in plans and procedures:

- ShakeMaps and HAZUS estimates of losses proved invaluable in initiating state response well in advance of receipt of Situation Assessments and request for resources from local governments. Additional training and exercising in the use of these tools will enhance staff confidence in their application to strategic decision making.
- Inadequate number of staff at local and regional level agencies severely delays initial response and analysis by the staff with most local knowledge. Reassignment of staff to emergency operations in or near the impact region is impractical in the immediate response phase. Communications, loss estimation tools and information systems should be enhanced to enable personnel remote from the disaster region to assume response responsibility until local staff can be augmented and are capable to take a ‘hand off.’
- Infrequent disasters and inadequate training do not prepare staff for managing the intensity and uncertainties confronted in the initial hours of response. GGEX 06’s simulation of real time ramping up and play resulted in stress, frustration and confusion similar that that experienced in real disaster operations. Training should emphasize the role of emergency managers in the ramping up of response capability when demands for analysis are intense, requests for assistance are overwhelming, information contradictory and confusing; and intelligence inadequate. While a cold start exercise is disruptive and costly, it may be the only way to simulate and train for the initial conditions that will confront responders at the local and state levels. .
- Emergency response training is not adequate to test systems and prepare staff who would be expected to participate in catastrophic disaster response events. Systems and facilities need to accommodate and integrate multiple functions, including fire suppression, law enforcement, health and medical response, care and shelter, transportation and supporting agencies. Collaboration and fusion of conflicting priorities for resources can only be achieved by adequate communications and co-location.
- Significant gaps remain in the communication of situation analysis and resource requests between local governments and regional and state facilities. Information systems and training need to be enhanced, and implemented, particularly in assessing the overall situation and setting priorities for allocating scarce resources in the initial

response when demands are great, credible intelligence is sparse, and resources are limited.

- Coordination between State and Federal agencies is inadequate to support catastrophic disaster response. Plans and training should specifically focus on integrating the federal response and capabilities to ensure the efficient acquisition of federal resources and their timely application.

Next Steps in Catastrophic Disaster Response

Using a regional scenario with realistic time history in GGEX06 identified a number of gaps in plans, concepts of operations, organizational relationships, staffing capability and procedures between local governments and the State of California, and between the State and the Federal Emergency Management Agency in responding to a sudden onset catastrophic event. In response, early in 2007 the State and FEMA initiated the development of plans and procedures for responding to catastrophic earthquake events in both northern and southern California. The new plans will address the issues and shortfalls identified in GGEX06 and will be the basis for future training and exercises to ensure their applicability in ramping up during catastrophic events.

Post Script

In the three years since the Golden Guardian Exercise in 2006, the state and federal governments have conducted regional response exercises in both northern and southern California generally modeled but far less comprehensive than the GGEX06 event. Many issues related to the initiation of response to a sudden onset event and the relationship among federal, state and local government have not been resolved and will continue to be addressed in catastrophic and regional response planning efforts in the state. In the mean time, the current economic crisis has forced reductions in staffing and capacity for state and local emergency management.

References

[1] ShakeMaps are real-time earthquake ground motion map provided by the USGS in cooperation with the California Integrated Seismic Network (CISN) strong motion networks.

<http://earthquake.usgs.gov/eqcenter/shakemap/>

[2] <http://earthquake.usgs.gov/regional/nca/1906/shakemap/>

[3] The **Hazards U.S. Multi-Hazard (HAZUS-MH)**, is a nationally applicable standardized methodology and software program that estimates potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS).

[4] Charles Kircher, Hope Seligson, Jawhar Bouabid & Guy Morrow, *When the Big One Strikes Again—Estimating Losses Due To a Repeat of the 1906 San Francisco Earthquake*, **Earthquake Spectra**, April 2006, v22, Issue S2