

## **AFTER THE *BIG ONE*, WILL CRITICAL COUNTY SERVICES SURVIVE?**

### **SUMMARY**

There is a 67% probability that Southern California will be hit by a magnitude 6.7 or larger earthquake in the next 30 years according to the Uniform California Earthquake Rupture Forecast.<sup>1</sup>

The 2007-2008 Orange County Grand Jury studied the issue of nonstructural earthquake hazard mitigation in County government buildings and how it is being addressed. The Grand Jury found that safety inspections and mitigation are either being done inconsistently or not at all. Critical buildings, such as the Loma Ridge Emergency Operations Center (EOC), the Orange County Fire Authority Emergency Operations Center,<sup>2</sup> the Sheriff-Coroner Department Forensic Science Services Division, and others, do not have consistent nonstructural earthquake hazard mitigation standards or inspections.

There is a lack of adequate nonstructural earthquake hazard mitigation standards consistently applied across all County buildings. During an earthquake, many of the critical County building contents and furnishings could shift or fall, causing injuries to personnel and damage to critical equipment, such as computers or communication equipment, causing a failure of operating capability at a critical time.

The Grand Jury concluded that the County must insure that **all** data center areas, housing critical computing and communication equipment, should meet guidelines similar to the ones in FEMA 74 to prevent earthquake damage to critical equipment. Additionally, any data centers with water fire suppression systems should replace them with inert gas systems.

The Grand Jury also concluded that the County should revert to a centralized Safety Office structure to ensure uniformity in standards, coordination between all departments and consistent enforcement. Further, centralization would eliminate confusion regarding the reporting structure and eliminate possible conflicts of interest when employees inspect their own departments.

### **REASON FOR INVESTIGATION**

A 1998-1999 Grand Jury Report<sup>3</sup> on “Safety Concerns at the Orange County Emergency Operations Center” (EOC) raised nonstructural earthquake damage concerns. In its summary the report stated “...many of the contents and furnishings of

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<sup>1</sup> The 2007 Working Group on Earthquake Probabilities released the Uniform California Earthquake Rupture Forecast (UCERF). The study was organized by the Southern California Earthquake Center, the U.S. Geological Survey, the California Geological Survey, and the California Earthquake Authority.

<sup>2</sup> The Orange County Fire Authority is an independent joint-powers agency with its own governing board which includes representatives of the Board of Supervisors and member cities.

<sup>3</sup> [www.ocgrandjury.org](http://www.ocgrandjury.org)

the EOC would not withstand the tremors that the building itself could easily tolerate. Such conditions could lead to personnel injuries and the lack of operational capability at a critical time. The EOC may not function when it is needed most.”

During a tour of the Loma Ridge EOC on August 13, 2007, current Grand Jury members observed that some of these issues, such as securing computer servers, printers, copiers, flat screen monitors and vending machines in the cafeteria, have not been resolved. During the Orange County Fire Authority Emergency Operations Center tour, Grand Jury members observed that none of the flat screen monitors in the Emergency Communications Center were secured.

During other tours of critical County buildings and departments, Grand Jury members observed little or no consistency in securing critical equipment, large cabinets and other heavy objects. When questioned the Safety Officer or Department Safety Representative (DSR) for these agencies expressed a lack of knowledge of Federal Emergency Management Agency (FEMA) guidelines published on the issue of Nonstructural Earthquake Hazard Mitigation.<sup>4</sup>

Discussions with Orange County Safety Office management revealed that the County lacks any standards for nonstructural earthquake hazard mitigation. Some departments, such as the Orange County Sheriff-Coroner Department, are not following the existing County Safety Office guidelines on this subject. County guidelines are minimal compared to those suggested by FEMA.

A report entitled “Data Center Facilities Review,” dated August 27, 2007,<sup>5</sup> which reviewed all the major data center facilities in the County of Orange, found among many other deficiencies:

- OC Waste & Recycling (formerly the Integrated Waste Management Department) data center – “...none of the server racks are bolted to the floor to protect against damage from a major earthquake.” The fire suppression system is the standard building system with water in the pipes.
- Registrar of Voters data center – The fire suppression system is gas, however, the report states: “Room appears to be unsealed.... If room is not sealed, the fire suppression system may not prove effective... in the event of a gas discharge.”
- John Wayne Airport computer room – Under fire suppression, the report stated: “No visible smoke or heat sensors.... No gas suppression.”

An audit of the Probation Department’s Internal Controls by the Auditor-Controller, dated March 3, 2008, stated: “...a sprinkler head [that] discharged in a concealed vent duct resulting in major flooding of the information technology (IT) offices and the

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<sup>4</sup> FEMA 74 / September 1994

<sup>5</sup> Source: Economic Analysis prepared by Excipio Consulting and Unisys for Orange County

computer room. The computer room did not have water detectors. The flooding resulted in an 18-hour interruption to critical applications.”

## **METHOD OF INVESTIGATION**

The Grand Jury investigated the issue of non-structural earthquake safety hazards in County buildings by:

- Reviewing the 1998-1999 Orange County Grand Jury report, *Safety Concerns at the OC EOC*
- Touring the Orange County Loma Ridge Emergency Operations Center, the Orange County Fire Authority Emergency Operations Center and multiple other County buildings
- Conferring with personnel at the Orange County Executive Office (CEO) and interviewing County Safety Office management
- Reviewing a report entitled *Data Center Facilities Review*, dated August 27, 2007<sup>6</sup>
- Speaking with the California Governor’s Office of Emergency Services, Coastal Region Branch, and with management personnel in the safety offices of other counties
- Reviewing Federal Emergency Management Agency (FEMA) document entitled, *Reducing the Risks of Nonstructural Earthquake Damage – a Practical Guide*, FEMA 74 – September 1994
- Reviewing the Orange County Safety Office website<sup>7</sup> and the safety and health inspection checklists of several departments for 2007
- Conducting internet research on the issue of mitigating nonstructural earthquake safety hazards and fire codes pertaining to data centers

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<sup>6</sup> Source: Economic Analysis prepared by Excipio Consulting and Unisys for Orange County

<sup>7</sup> [http://intra2k3.ocgov.com/ceo\\_risk\\_mgmt/resources.html](http://intra2k3.ocgov.com/ceo_risk_mgmt/resources.html)

## BACKGROUND

### Definitions

To understand the important issues discussed in this report, several terms used throughout are defined below:<sup>8</sup>

#### *Structural*

The structural portions of a building are those that resist gravity, earthquake, wind and other types of loads. These are called structural components and include columns (posts and pillars), beams, braces, floor or roof sheathing, slabs, or decking, load-bearing walls (i.e., walls designed to support the building weight and/or provide lateral resistance), and foundations.

#### *Nonstructural*

The nonstructural portions of a building include every part of the building and all its contents with the exception of the structure—in other words, everything except the columns, floors, beams, etc. Common nonstructural components include ceilings, office equipment, computers, inventory stored on shelves, file cabinets, heating, ventilating, and air conditioning equipment, electrical equipment, furnishings, and lights, etc.

#### *Nonstructural damage*

Three types of earthquake risks are associated with nonstructural components: life safety, interruption or loss of essential functions and property loss.

#### *Life safety*

People could be injured or killed by damaged or falling nonstructural components, such as a tall and heavy file cabinet, ceiling tiles, overhead lights, etc.

#### *Loss of function*

Nonstructural damage may make it difficult, or impossible, to carry out the functions normally performed at the facility.

#### *Property loss*

Damage to nonstructural elements and contents of a building can be costly since these components account for the vast majority of building costs. Property losses may be the result of direct damage to a nonstructural item or of consequential damage—that is, indirect losses resulting from direct damage. As an example, if water pipes or fire sprinkler lines break, the overall property losses will include the cost to repair the piping plus the cost to repair water damage to the facility.

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<sup>8</sup> Source: [FEMA 74 Field Manual/9-2005](#)

If the gas line to a water heater ruptures and causes a fire, clearly the property loss will be much greater than the cost of a new pipe fitting.

*Property loss examples<sup>9</sup>*

After the 1989 Loma Prieta earthquake, 26 out of 32 data centers surveyed in the Bay Area were temporarily out of operation due to the movement of large pieces of computer equipment over distances ranging from a few inches to 26 feet. Thirteen of these data centers were out of operation for periods ranging from four to 56 hours. Other sources of outages included: loss of outside power and overturned equipment.

After the 1994 Northridge earthquake, nonstructural damage caused temporary closure, evacuation, or patient transfer at **ten** essential hospital facilities. These hospitals generally had little or no structural damage but were rendered temporarily inoperable, primarily because of water damage. At many of these facilities, water leaks occurred when fire sprinkler, chilled water, or other pipelines broke. Hospital personnel were apparently unavailable or unable to shut off the water, and in some cases water was flowing for many hours. At one facility, up to two feet of water was reported at some locations in the building as a result of damage to the domestic water supply tank on the roof.<sup>10</sup>

### **Problem in Orange County**

The 2007-2008 Grand Jury reviewed a 1998-1999 Grand Jury report, *Safety Concerns at the Orange County Emergency Operation Center (EOC)*. The report found deficiencies in the prevention of damage to equipment and injuries to personnel in case of an earthquake. During a tour of the EOC, the current Grand Jury found that some of the deficiencies pointed out in the 1998-1999 report had not been addressed and enforcement of nonstructural earthquake hazard mitigation was not consistent.

Tours of other critical buildings in the County, such as the Orange County Fire Authority, the Sheriff-Coroner Forensics Lab and others, revealed that enforcement of nonstructural earthquake hazard mitigation is minimal. Additionally, the Safety Officer and Department Safety Representatives for the above departments had no knowledge of the FEMA 74 document, referenced in the 1998-1999 Grand Jury report.

Interviews with County management personnel and the County Safety Office revealed a lack of standards in County government for nonstructural earthquake hazard mitigation. A review of the safety and health inspection checklists for 2007 revealed that even the minimal guidelines published by the County Safety Office on its website in 2001 are disregarded by most County departments.

There appears to be confusion on the reporting procedure among the County's Safety Officer, the four full-time Safety Officers and the Department Safety Representatives.

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<sup>9</sup> FEMA 74 / September 1994

<sup>10</sup> These examples are offered to demonstrate damage at essential buildings in other jurisdictions

After the Orange County bankruptcy in 1994, the County decentralized many functions, including safety. This resulted in the four largest agencies, OC Waste & Recycling, Sheriff-Coroner Department, Health Care Agency and OC Infrastructure (formerly Resources Development & Management Department) having their own full-time Safety Officers. According to the County Safety Office, each of the remaining 86 departments have a Department Safety Representative who has other full-time duties and, according to one official, no formal safety training. The present County system lacks uniformity, coordination and consistency. Conflicts of interest may occur when employees inspect their own departments.

### **Methods for reducing nonstructural earthquake hazards**

A publication entitled, *FEMA 74 /September 1994 - Reducing the Risks of Nonstructural Earthquake Damage – a Practical Guide* was originally developed in Southern California under the auspices of the Federal Emergency Management Agency.<sup>11</sup> Samples of the guidelines in the FEMA document are:

- Anchoring vending machines
- Laterally bracing fire sprinkler piping
- Bracing ceilings so as not to rupture fire sprinkler heads
- Anchoring heavy electrical equipment, such as transformers
- Anchoring heating, ventilating, air conditioning chillers
- Having flexible joints in fire sprinkler pipes, chiller pipes, gas lines, etc.
- Anchoring heavy computer equipment such as server racks to the floor slab
- Anchoring critical communications and computer equipment

According to the Coastal Region Branch of the California Governor’s Office of Emergency Services, the FEMA 74 document is being used as a guideline on the subject of nonstructural earthquake safety.

Research on the Internet revealed what other agencies are doing on the subject, such as the Lawrence Livermore National Laboratory (LLNL) in Livermore, California. Their Environment, Safety, and Health Manual, Volume II, Part 22.4, dated September 11, 2007, states in paragraph 7.0, “Numerous federal, state, and local codes are concerned with the structural integrity of buildings during earthquakes. ....However, only a few mandatory standards, such as California ‘Elevator Safety Orders,’ deal with nonstructural items that have been shown to be of importance in recent California earthquakes.” It added, “The LLNL seismic safety standards listed below were developed from local experience and after review of experiences by others resulting from many earthquakes around California and the rest of the world. They were also generated from other recommended standards.” Some of these standards are:

- Desktop computers, monitors, printers, fax machines and similar items, shall be restrained.

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<sup>11</sup> See References for other FEMA documents on the subject

- Data center raised floors shall be braced for seismic loading. Floor panels shall be secured.
- All cabinets and vending machines five-feet tall or more, shall be secured.
- All electrical equipment such as transformers, switchboards, control panels and battery racks, shall be anchored.

### **Data Center fire suppression**

Some County data centers use a sprinkler system with water for fire protection. This system is inadequate because it only responds when a fire has substantially developed. The release of water will damage all the electronic equipment in the vicinity of the fire. Fire and smoke from such an incident will adversely affect the operation of the facility.

Instead of using water for fire suppression in critical electronic equipment spaces, the solution is to use a clean agent fire extinguishing system. A clean agent is a liquid, which turns to gas when released into the air. The clean agent used should be based upon the Standard on Clean Agent Fire Extinguishing Systems, 2004 Edition published by the National Fire Protection Association.

### **CONCLUSION**

Orange County government is not prepared for an earthquake of similar magnitude to the 1994 Northridge or the 1989 Loma Prieta earthquakes. The 2007-2008 Orange County Grand Jury concluded that damage to the nonstructural components of County buildings may result in injuries to personnel and the disabling of critical components such as computers and telecommunications.

County data processing centers, the Sheriff-Coroner Department's Loma Ridge Emergency Operations Center and the Orange County Fire Authority's Emergency Operations Center are facilities with essential functions that must remain operational during and after an earthquake. Damage to their nonstructural elements, which include building utilities such as water pipes, chilled water, fire sprinkler lines, HVAC ducts, etc., can cause a loss of functionality.

Newly established guidelines, similar to the ones in FEMA 74, need to be developed and applied in inspecting these critical County buildings.

## **FINDINGS**

In accordance with California Penal Code sections 933 and 933.05, each finding will be responded to by the government entity to which it is addressed. The responses are to be submitted to the Presiding Judge of the Superior Court. The 2007-2008 Orange County Grand Jury has arrived at the following findings:

- F-1a The current decentralized safety inspection system lacks uniformity, coordination and consistency, and results in confusion in the reporting structure.**
- F-1b Coordination is insufficient between the full-time safety officers at OC Waste & Recycling, Sheriff-Coroner Department, Health Care Agency and OC Infrastructure, and the County Safety Office.**
- F-2 86 Department Safety Representatives have other duties and responsibilities and no formal safety training. Conflicts of interest may arise when employees inspect their own departments, and any such inspection lacks organizational independence.**
- F-3 There is a lack of adequate nonstructural earthquake hazard mitigation standards consistently applied across all County buildings, including those owned and occupied by the Orange County Fire Authority.**
- F-4 Some County data centers housing critical computer and telecommunication equipment are using water in their fire suppression system rather than inert gas.**

**Responses to Findings F-1a, F-1b, F-2, F-3 and F-4 are requested from the County Executive Officer.**

**Responses to Findings F-1b and F-4 are required from the Orange County Sheriff-Coroner.**

**Response to Finding F-3 is required from the Orange County Fire Authority.**



## RECOMMENDATIONS

In accordance with California Penal Code sections 933 and 933.05, each recommendation will be responded to by the government entity to which it is addressed. The responses are to be submitted to the Presiding Judge of the Superior Court. Based on the findings of this report, the 2007-2008 Orange County Grand Jury makes the following recommendations:

- R-1a Revert to a centralized County safety organizational structure reporting directly to the Deputy CEO in charge of Risk Management.**
- R-1b Transfer the full-time Safety Officers positions at OC Waste and Recycling, OC Infrastructure, Health Care Agency and Sheriff-Coroner Department to the centralized County Safety Office.**
- R-2 Transfer the safety inspection and enforcement responsibilities from Department Safety Representatives to the centralized County Safety Office.**
- R-3 Adopt uniform and consistent standards on nonstructural earthquake hazard mitigation based on guidelines similar to the ones in FEMA 74. These standards should be applied to all critical County buildings including the Sheriff-Coroner Department, Orange County Fire Authority, among others, and all County data centers.**
- R-4 Require all data centers in Orange County, including the Loma Ridge EOC and others, to replace water-based fire suppression systems with those using inert gas, based upon the Standard on Clean Agent Fire Extinguishing Systems, 2004 Edition published by the National Fire Protection Association.**

**Responses to Recommendations R-1a, R-1b, R-2, R-3 and R-4 are requested from the County Executive Officer.**

**Responses to Recommendations R-1b and R4 are required from the Orange County Sheriff-Coroner.**

**Response to Recommendation R-3 is required from the Orange County Fire Authority.**

## REQUIRED RESPONSES:

The California Penal Code specifies the required permissible responses to the findings and recommendations contained in this report. The specific sections are quoted below:

§933.05

(a) For purposes of subdivision (b) of Section 933, as to each grand jury finding, the responding person or entity shall indicate one of the following:

- (1) The respondent agrees with the finding.
  - (2) The respondent disagrees wholly or partially with the finding, in which case the response shall specify the portion of the finding that is disputed and shall include an explanation of the reasons therefore.
- (b) For purposes of subdivision (b) of Section 933, as to each grand jury recommendation, the responding person or entity shall report one of the following actions:
- (1) The recommendation has been implemented, with a summary regarding the implemented action.
  - (2) The recommendation has not yet been implemented, but will be implemented in the future, with a timeframe for implementation.
  - (3) The recommendation requires further analysis, with an explanation and the scope and parameters of an analysis or study, and a timeframe for the matter to be prepared for discussion by the officer or head of the agency or department being investigated or reviewed, including the governing body of the public agency when applicable. This timeframe shall not exceed six months from the date of publication of the grand jury report.
  - (4) The recommendation will not be implemented because it is not warranted or is not reasonable, with an explanation therefore.

## **REFERENCES**

“Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide”, Federal Emergency Management Agency (FEMA) 74, September 1994

“Earthquake Hazard Mitigation for Nonstructural Elements”, Field Manual, FEMA 74-FM, September 2005

Nonstructural Earthquake Mitigation Guidance Manual, FEMA/URS May 28, 2004

Robert T. Stafford Disaster Relief and Emergency Assistance Act, Section 404

Uptime Institute, Inc. ([www.uptimeinstitute.org](http://www.uptimeinstitute.org))

Environment, Safety and Health Manual: Document 22.4 Earthquakes, Lawrence Livermore National Laboratory, Livermore, California, 2007

Victor Avelar, “Mitigating Fire Risks in Mission Critical Facilities”, White Paper #83, American Power Conversion (APC)

”Standard for the Protection of Information Technology Equipment” Nation Fire Protection Association, 2003