Proposed Best Practice

Water Supply Seismic Improvement Program
East Bay Municipal Utility District (EBMUD)
 Implemented: 1991-2005

Description
The San Francisco East Bay region water supply is subject to extremely high seismic hazards. EBMUD’s $200 million Seismic Improvement Program (SIP) is an integrated planning, engineering, and construction program that has made major progress toward significantly increasing the seismic reliability of the region’s water supply.

Problem
The East Bay Municipal Utility District (EBMUD) serves about 1.3 million water and 600,000 wastewater customers in Alameda and Contra Costa Counties, most of whom are west of the Hayward fault. EBMUD receives most of its supply from east of the Hayward fault, with its Claremont Tunnel and other supply lines crossing the fault. The 1989 Loma Prieta earthquake was at some distance from the District, yet still caused damage to District facilities, making it clear that better understanding of the district’s seismic risk was badly needed.

Solution
In 1991, EBMUD undertook a comprehensive seismic risk assessment of its water supply, water treatment, and water distribution facilities. Service goals for post-earthquake performance were established, and system performance levels were evaluated under four scenario earthquake events. Three of the scenario earthquakes were chosen to represent severe shaking from events on the Hayward fault. For the magnitude 7.0 scenario earthquake on the Hayward fault, for instance, it was anticipated that two-thirds of the district’s customers would be immediately without water. The economic losses associated with this scenario earthquake were staggering.

A range of possible improvement programs was developed for presentation to the EBMUD Board of Directors, whose role it was to select an appropriate level of reliability and robustness for post-earthquake system performance. Based on feedback from an extensive public outreach and education program, the board chose an alternative with an intermediate level of cost. The selected alternative greatly improved the district’s capacity for ensuring operations following severe earthquakes and was funded through direct charges to customer water bills. The factors used in fairly assigning costs to various users considered the two major benefits of the system: post-earthquake fire flow capacity and post-earthquake drinking water supply capacity, where each factor represents one half the total program cost. The drinking water supply following an earthquake must be sufficient to ensure adequate water for essential uses—drinking and sanitation.

Resources and Examples
Now entering its seventh year, the EBMUD Seismic Improvement Program is on track to meet its aggressive ten-year goal of completion. Major seismic mitigation tasks include:

- The Southern Loop, a new 11-mile-long pipeline, was completed in June 2002. This new pipeline allows EBMUD to shuttle water between east and west in the southern part of its service area under emergency conditions.
- Many of the older reservoirs that are either not anchored or inadequately anchored to their foundations are being reinforced. Many reservoir valve pits, which hold critical valves and instruments and have unstable covers, are being upgraded.
Isolation valves with emergency bypasses for pipelines crossing the Hayward and Calaveras faults are being installed. These valves have the ability to tolerate the expected 3 to 5 feet of displacement on the Hayward fault, and 2 to 3 feet of displacement on the Calaveras fault.

Designs have been completed for the anchoring of critical equipment and storage shelves at the district office, maintenance, and warehouse buildings. Installation will start in conjunction with building structural upgrades.

Vulnerable treatment plant systems are being seismically upgraded.

Several of the most vulnerable pumping plants have been strengthened.

**Adaptability/Sustainability**

EBMUD officials have learned several important lessons through the implementation of the Seismic Improvement Program, which can serve as a guide for adaptation to other utilities:

- Establishment of specific post-earthquake performance goals is a prerequisite in defining the scope and cost of mitigation alternatives necessary for responsible decision-making.
- Emphasis on system reliability, rather than individual facility performance, produces a cost-effective mitigation program.
- Outreach and education are useful to develop awareness of both the earthquake threat and the potential impact on daily life, and ensure public backing of mitigation efforts.
- Separating seismic mitigation monies and management from other capital improvement projects helps to facilitate cost and schedule tracking and ensures that an advocate for seismic risk reduction is always present in the overall organization.

**References**