Enhancing Public Safety & System Resiliency at BART

Loma Prieta Earthquake Commemorative Symposium

October 17, 2009
3 Major Initiatives in Response to Loma Prieta

- Earthquake Safety Program
- Local Hazard Mitigation Plan
- Emergency Response and Recovery Plans
BART Today

5 Lines

104 Miles (167 Kilometers)

- Underground = 37 Miles (60 Km)
- Aerial = 23 Miles (37 Km)
- Surface = 44 Miles (71 Km)

43 Stations

360,000 Daily Ridership

$15 Billion Replacement Cost
Hayward Fault parallel to BART and crosses BART.

1868 last major rupture of Hayward Fault (130- to 170-year return cycle).

Four earthquake scenarios most likely to damage BART:

- 7.0 Hayward Fault
- 8.0 San Andreas Fault
- 6.7 Concord Fault
- 6.7 Calaveras Fault
Keeping the Bay Area Moving

A Vital Transportation Link

- 360,000 Daily Weekday Ridership
- Approx. Half of Rides Cross Bay
- During Peak Commute, BART Carries as Many People as the Bay Bridge
- 27 Million Trips/Year to or from Contra Costa County
- 72 Million Trips/Year to or from Alameda County
- 49% Downtown Oakland Workers Commute on BART
- Since 1970, BART Service Enabled San Francisco to Accommodate Estimated 113,000 Jobs
- BART Riders Spend Ave. $400 Million on Retail in San Francisco Annually
BART’s Earthquake Safety Program

- Began with Vulnerability Study of the Existing System
- Established Performance Criteria
- Developed Potential Upgrades to Strengthen the System
- Identified Most Reasonable and Cost-Effective Actions
Potential Service and Traffic Impacts

- Portions of BART Could Be Closed for Repair for 2.5 Years or Longer
- 360,000 More Trips Competing for Space on a Damaged Roadway System
- During Peak, Translates to an Additional 60 to 80 Minutes Commute Delay along the Hwy 24 Corridor and Other Roadways
Transbay Tube Vulnerability

- Capacity of Joints
ESP Retrofit to Seismic Joints
(Transbay Tube)
Aerial Guideway Vulnerability

Total of 1,918 Aerial Guideway Supports

- Foundations too Small
- Columns Lack Shear Capacity
Strengthen Foundations

“Jacket” Columns (10-15%)

Add Shear Keys (10-15%)

Add Piles (Where Appropriate)

Similar Station Retrofits
Retrofit Locations

- Transbay Tube and Associated Structures
- 22 Miles of Aerial Guideways
- 18 BART Stations
- 6 Parking Garages
- 4 Train Maintenance Yards and the Oakland Shops
- 1 BART-Owned SF Muni Facility (Church Street Station)
- Operations and Administration Structures
- Power, Mechanical, Train Control and Communications Equipment
Multi-Jurisdictional Local Hazard Mitigation Plan (LHMP)

for the San Francisco Bay Area
LHMP Objectives

- Build a More Disaster-Resistant Region
- Enhance Disaster Recovery Capabilities
- Qualify for FEMA Hazard Mitigation Grants
Earthquakes: BART’s Largest Risk

- Prioritize Mitigation Strategies
- Inventory Critical Facilities
- Identify Areas for Improvement
BART is Committed to Safeguarding Bay Area Transportation and Economic Well-Being
BART Emergency Response

- Seismic Sensor Alarms
  - 0.1 g Sensors
  - Strong Motion Sensors
  - In the Future, Transbay Tube Displacement Transducers and Accelerometers

- Exploring the Potential Merits of Earthquake Early Warning Technology
Potential Uses for Seismic Alarms

Train Control
- Stop or slow trains in some areas
- Keep trains in dangerous areas moving to safe areas
- Hold trains at platforms
- Automate notification to OCC, train operators, etc. before infrastructure potentially fails
- Automatically bring up USGS shake map web page in OCC

Stations and Buildings
- Open garage doors so that rescue vehicles are not trapped
- Close natural gas and water valves
- Put electrical power systems in a safe operating modes
- Move elevators to the nearest floor and opening their doors
- Gently stop escalators so that the riders do not stumble
- Announce over PA in stations for patrons to move back from the platform edge
- Announce over PA in shops for workers to move away from dangerous areas
- Bring emergency backup power systems into a state of readiness
- Initiate save or backup of critical computer files

Provide warning to parties outside of BART
Shake Map Data

Northern California ShakeMap: Estimated Instrumental Intensity - Microsoft Internet Explorer

SCENARIO: HaywardH+RC

Instrumental Intensity | Peak Ground Acceleration | Peak Ground Velocity | Spectral Response | Focal Mechanism

Download

-- Earthquake Planning Scenario --
Rapid Instrumental Intensity Map for HRC_H+Rc Scenario
Scenario Date: Thu Mar 6, 2003 04:00:00 AM PST

Plotted by QuakeFinder Inc.

About QuakeFinder
Summary:
Public Safety and System Resiliency

- BART Has Made Many Improvements in 20 Years Since Loma Prieta
- BART Recognizes Areas Where further Work is Warranted