Standards for Electric Power Systems

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Homeland Security Standards Panel (ANSI - HSSP)

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Performance Standards for Electric Power Systems--Framework Issues (1)

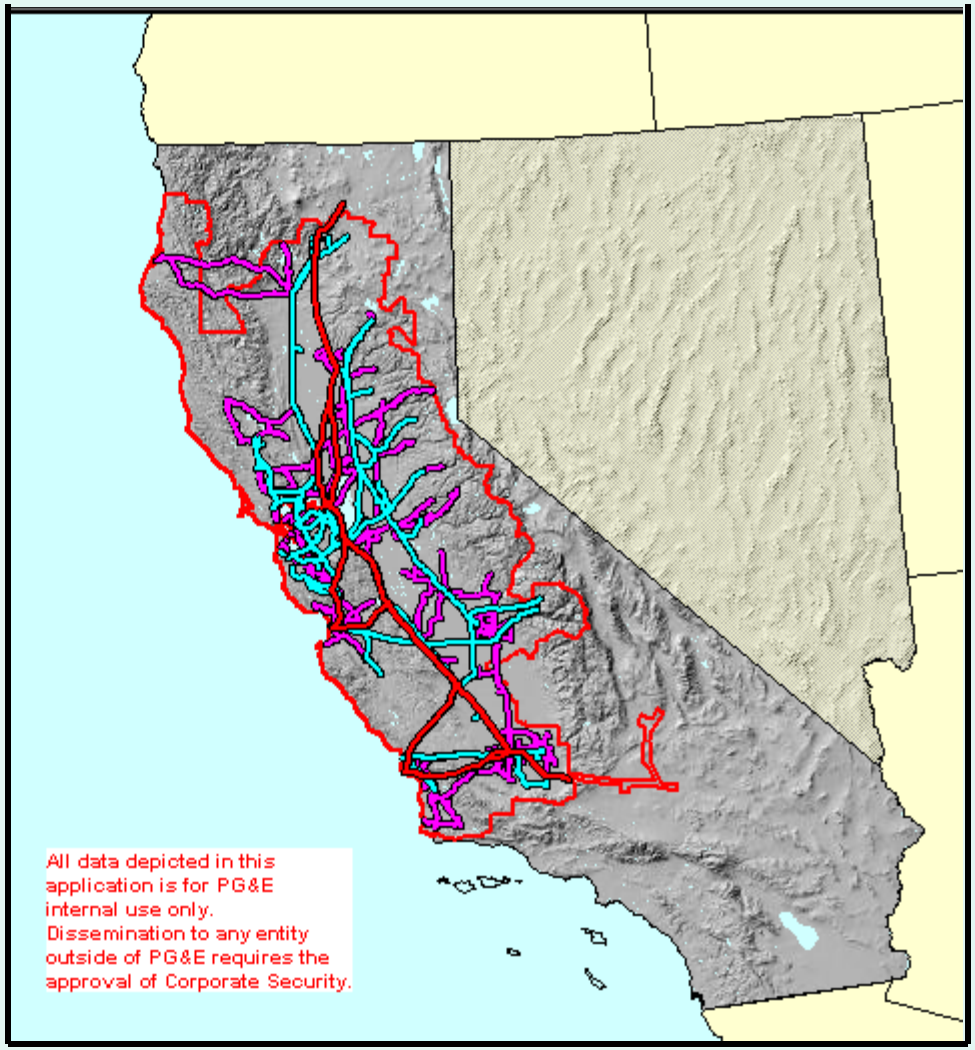
- Varying combinations of generation, transmission, and distribution
- Complex network of components within and connecting the built infrastructure
- Lifeline characteristics differ from buildings
  - Large interconnected spatial distribution
  - Large affected population
  - System function not directly related to component damage

Performance Standards for Electric Power Systems--Framework Issues (2)

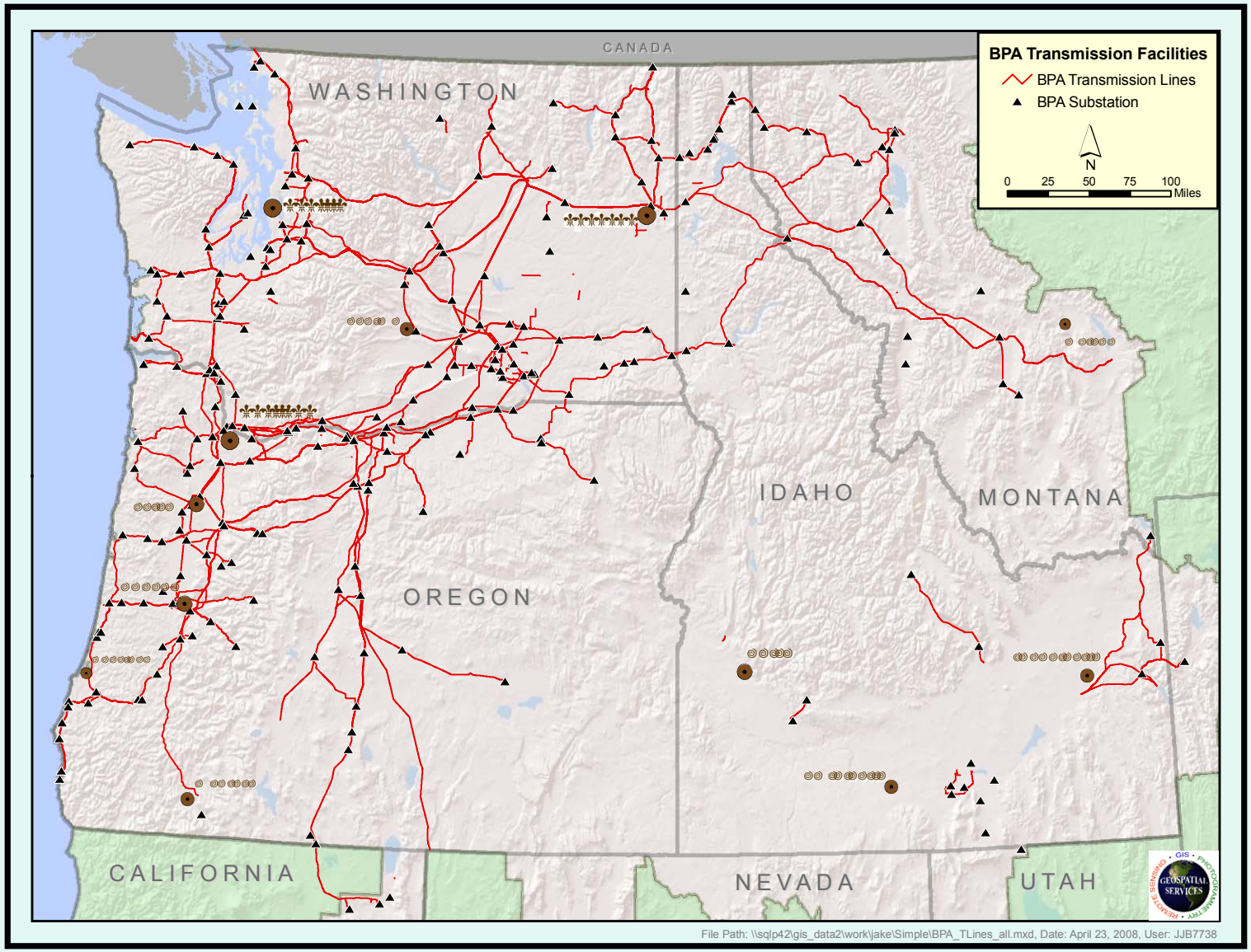
- Multiple ownerships and multiple jurisdictions make coordination complicated
- More than a century's development creates a huge legacy inventory and long-standing rights-of-way
- Utilities and regulators are familiar with "routine" hazard events and other reliability disruptions, not rare events
- Owners/operators have knowledge unique to each system

PG&E's Transmission System: 500, 230, 115 kv

- 1890 first generator; PG&E formed in 1905
- Interstate transmission
- Internal municipal utilities
- Serves 14,000,000 people



Bonneville Power Administration
Transmission Facilities Serve Multiple States



Policy on Acceptable Levels of Earthquake Risk for California Gas and Electric Utilities

- Prepared for the California Public Utilities Commission at request of the state's Seismic Safety Commission
- Prepared in 1995 by the ad hoc Inter-Utility Seismic Working Group
- Used experience of 1989 Loma Prieta and 1994 Northridge earthquakes

"Each California gas and electric power utility system shall withstand earthquakes to provide reasonable protection of life, to limit damage to property, and to provide for resumption of utility system functions in a reasonable and timely manner. An acceptable level of earthquake risk is the residual risk that remains when this policy has been fully implemented."

- Policy Implementation Checklist
  - Seismic Safety Program: identify hazards, assess vulnerability, carry out mitigations, practice emergency responses, update seismic criteria
  - Responsible staff
  - Adequate funds
  - Accountability to verify progress
- Goal is to meet societal needs

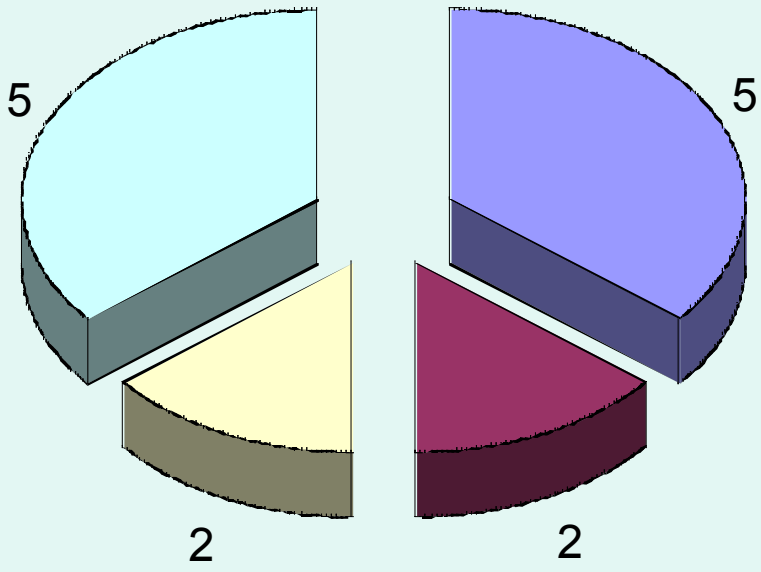
American Lifelines Alliance

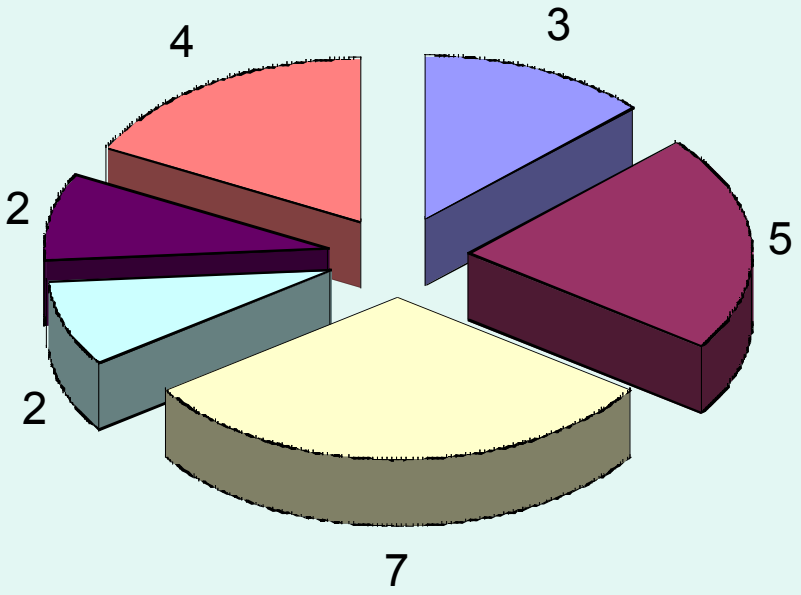
- A Public/Private partnership with the objective of reducing risks to utility and transportation systems from natural hazards and human threat events
- American Lifelines Alliance project initiated in 1998 under a cooperative agreement between FEMA and ASCE
- In 2002, ALA operations shifted to a project under the Multihazard Mitigation Council of the National Institute for Building Safety
- Project funding ended in 2006, final products issued in 2008

ALA Objective and Approach

- Facilitate the creation, adoption, and implementation of ***national consensus guidelines*** to improve lifeline performance during natural hazards and human threat events
  - Focus on existing practice, not research
  - Maximize use of standards developing organizations
  - Address lifeline systems and their key components (buildings are addressed by other existing guidance)
- Utilize utility industry participants and Corresponding Advisors to identify needed projects
- An updated matrix of lifeline types and available guidance documents served to make visible the breadth and depth of available information.

Distribution of ALA Projects

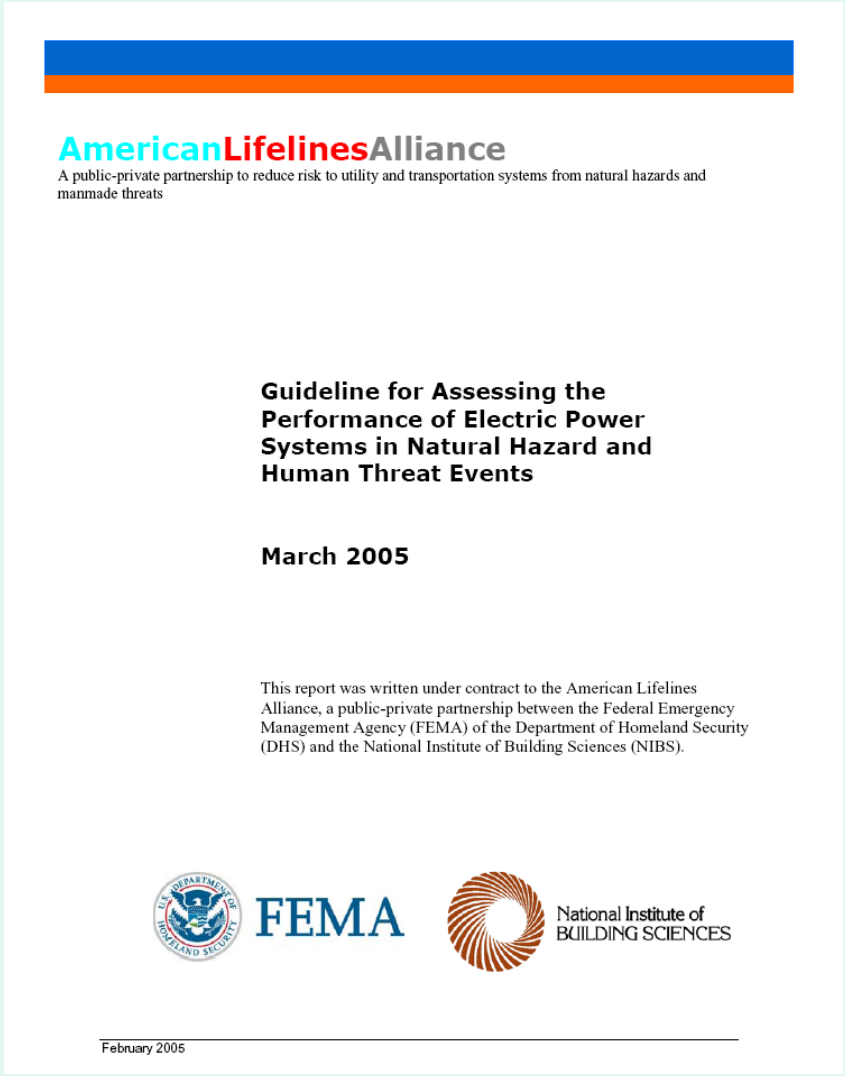




- Earthquake
- Flood
- Ice
- Multihazard

- Electric Power
- Oil and Gas Pipelines
- Water
- Equipment/Piping
- Transportation
- Waste Water

ALA Guidelines on Conducting Performance Assessments



AmericanLifelinesAlliance

A public-private partnership to reduce risk to utility and transportation systems from natural hazards and manmade threats

Guideline for Assessing the Performance of Electric Power Systems in Natural Hazard and Human Threat Events

March 2005

This report was written under contract to the American Lifelines Alliance, a public-private partnership between the Federal Emergency Management Agency (FEMA) of the Department of Homeland Security (DHS) and the National Institute of Building Sciences (NIBS).

FEMA

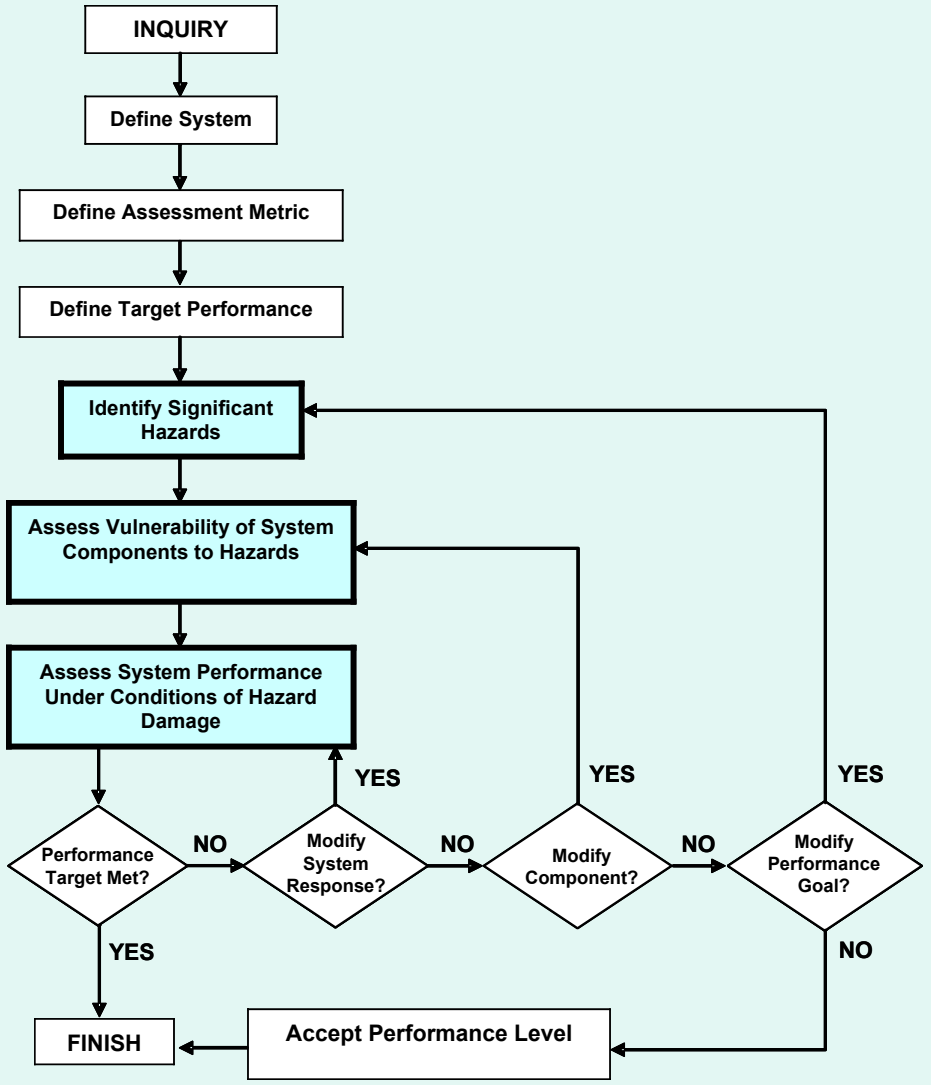
National Institute of BUILDING SCIENCES

February 2005

ALA also prepared guidelines for Oil and Natural Gas Pipeline Systems, and Water and Wastewater Systems

Generic Approach to Performance Assessment

- Begins with "Inquiry"
- Requires definition of how performance is measured
- Requires definition of a target level of performance
- Includes analyses of hazard, vulnerability, and system performance



ALA Project on Lifeline Interdependency

AmericanLifelinesAlliance

A public-private partnership to reduce risk to utility and transportation systems from natural hazards and manmade threats

Power Systems, Transportation and Communications Lifeline Interdependencies

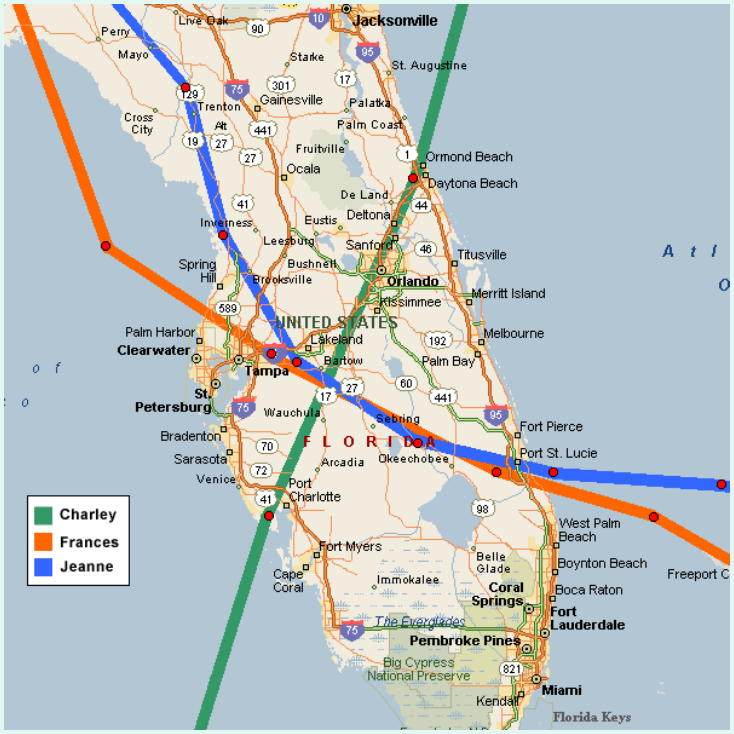
March 2006

FEMA

National Institute of BUILDING SCIENCES

Virginia Polytechnic Institute

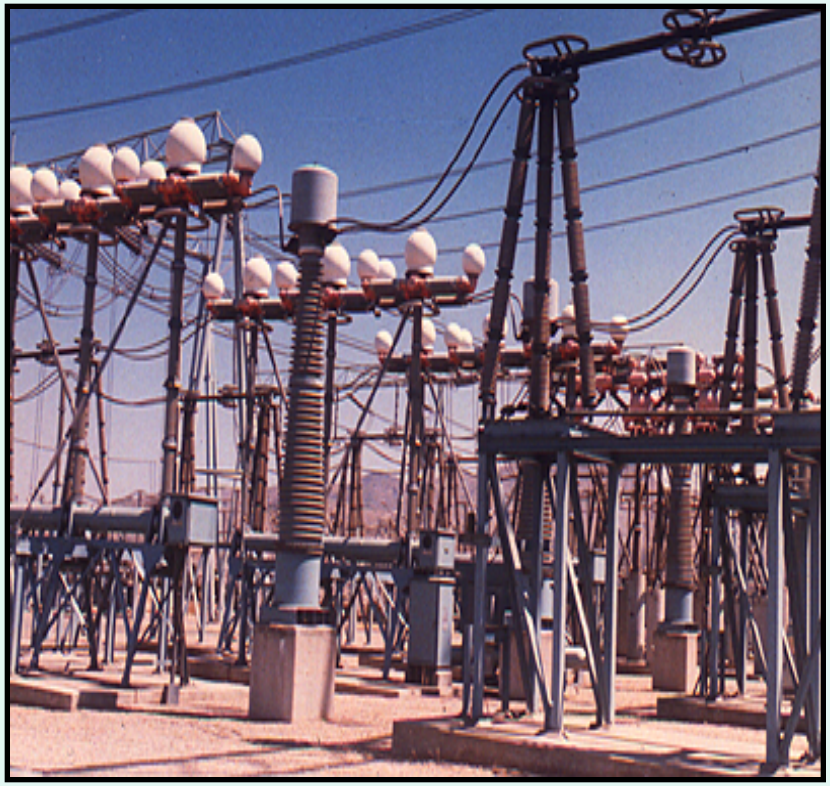
Dr. Frederick Krimgold et al.



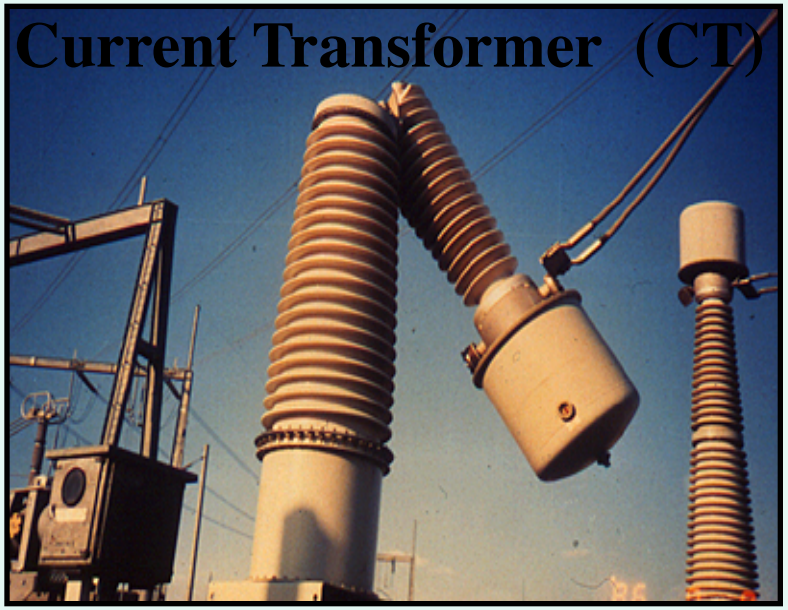
Tree-caused Damage Last Week in Enfield, Connecticut

LESLLOYD F. ALLEYNE/THE ASSOCIATED PRESS

North Palm Springs
6.2 M_w (1986)



Live Tank Power Circuit Breaker



Photos by D. Ostrom

Element	Natural Hazard	Guidance/Oversight
Generation		
Hydro	Earthquakes, Storms	Federal/State Dam Safety
Fossil	Earthquakes, Storms	Federal/State
Substation	Earthquakes, Storms	IEEE, ASCE, NESC
Transmission (HV)		
Substation	Earthquakes, Storms	IEEE, ASCE, NESC
Transmission Lines	Trees, Wildfires	NESC, PUC, FERC
Distribution (LV)		
Overhead lines	Earthquakes, Storms	NESC, PUC
Underground lines	Earthquakes, Storms	NESC, PUC
Substations	Earthquakes, Storms	NESC, PUC
Customer Buildings	Earthquakes, Storms	Building Codes

Electric Power Guidance (Partial List)

- IEEE 693: Recommended Practice for Seismic Design of Substations
- ASCE MOP 113: Substation Structure Design Guide
- National Electric Safety Code (NESC) (2007)
- Expert panels assessed performance for the M7.8 2008 Southern California ShakeOut (Porter and Sherrill, Earthquake Spectra, Vol. 27, no. 2, 2011)
- Numerous electric power research activities: NEHRP, DOE, EPRI, PEER/MCEER/MAE, and utility-sponsored projects (PG&E, BPA, LADWP, and others)

Recommendations

There needs to be a near-term focus on implementation of performance-oriented guidance based on current knowledge of hazards and vulnerabilities. Implementation issues such as investment priorities and confidentiality* could be addressed by utility-public agency partnerships. The time to get this implementation experience is now!

The ALA public-private approach to identifying and developing risk reduction guidance was successful and cost-effective; such activities should be resumed.

**Roadmap to National Earthquake Resilience*, National Research Council, 2011