

ATC-102 Project, Development of NEHRP Research and Implementation Earthquake-Resilient Lifelines Roadmap

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NIST National Institute of Standards and Technology



Under the National Earthquake Hazards Reduction Program

Conducted by the
NEHRP Consultants Joint Venture:



Applied Technology Council

and



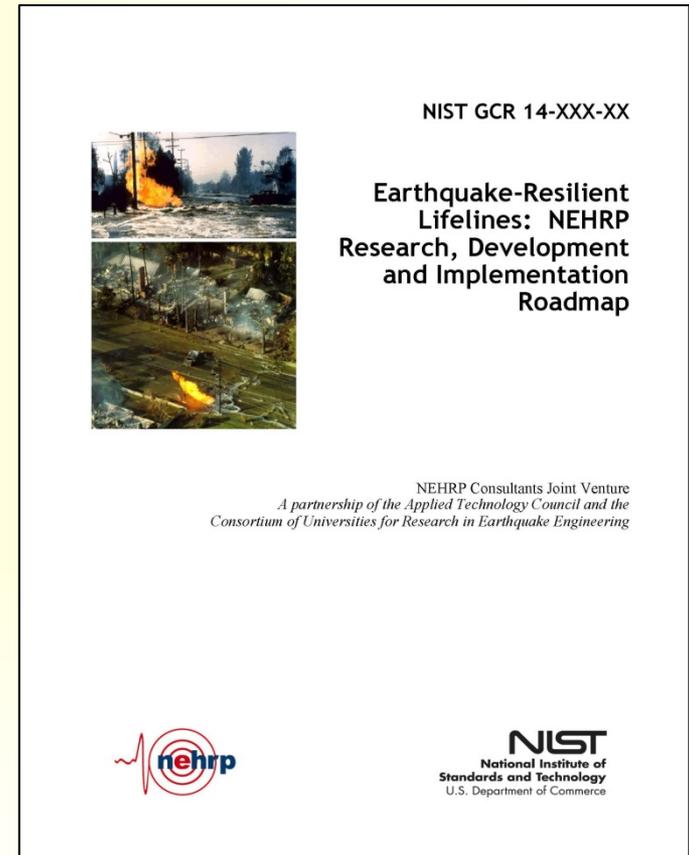
**Consortium of Universities for
Research in Earthquake Engineering**

ATC-102 Project Goal

- Development of a Roadmap Defining a 10-year Research, Development, and Implementation Program for NEHRP Activities to Improve Earthquake Resilience of the following Lifelines:
 - ✓ Electric Power
 - ✓ Gas & Liquid Fuels
 - ✓ Telecommunications
 - ✓ Transportation Networks
 - ✓ Water and Wastewater

ATC-102 Project Tasks

- ✓ Identify and analyze available resources and information
- ✓ Prioritize critical research, development, and implementation needs
- ✓ Plan & conduct review workshop (May 2014)
- ✓ In-person NIST program briefing (June 2014)
- ✓ Prepare final research/implementation roadmap (July 2014) (now undergoing final NIST review)



Project Participants

- **NIST Project Officer:**
 - ✓ Steve McCabe, Gaithersburg, Maryland
- **Project Manager:**
 - ✓ Chris Rojahn, Applied Technology Council
- **Project Technical Director:**
 - ✓ Tom O'Rourke, Cornell University
- **Lead Editor:**
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- **Project Technical Committee:**
- **Project Review Panel:**
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- Charles Scawthorn, SPA Risk, LLC., San Francisco, California
- Kathleen Tierney, Natural Hazards Center, University of Colorado
- Yumei Wang, Oregon Department of Geology and Mineral Industries, Portland

Roadmap Vision and Goals

- An integrated plan that identifies the key overarching issues and national needs for lifelines, and establishes a framework for addressing improvements in their collective and individual performance
 - ✓ Guide investments by NIST and other NEHRP agencies
- Helps local communities secure the “last mile” of distributed resources and services through resilient lifeline systems
- Underscores that Improved lifeline resilience is accomplished by focusing on national lifelines performance goals with a coherent and well-coordinated plan that addresses key socioeconomic and institutional issues, lifeline interdependencies, and the need to advance research, development, and implementation for both individual and collective lifeline systems

Key Features Addressed by the Roadmap

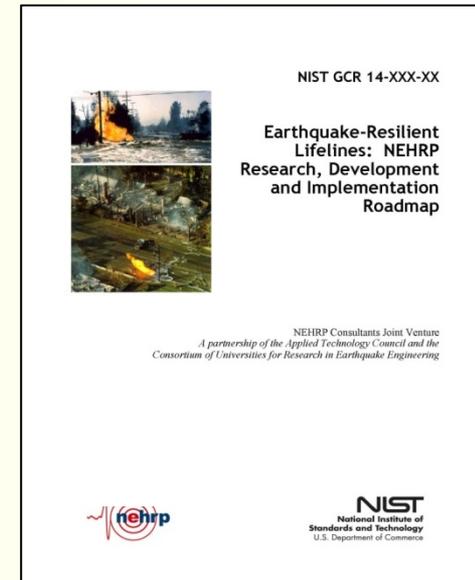
- Lifeline Interdependencies
- Socio-economic and Institutional Issues
- National Framework for Performance Goals, Guidelines, and Standards
- Program Management Issues

Value of a National Framework for Lifeline Earthquake Resilience

- Current guidelines, standards, and codes vary widely with little consideration of interdependencies and little consistency in performance objectives
- Move from current utility-specific crisis management to more integrated performance and community resilience approaches to management
- Provides framework for defining performance and recovery goals with respect to timelines and phased geographical restoration with stakeholder engagement (both community and owner/operator)
- Improved resilience of new and existing lifelines has long-term benefits - economic efficiencies, national security, and quality of life
- Coordination among NEHRP agencies and DOT, DOE, and DOD

Roadmap Contents

1. Introduction
2. Vision for Earthquake Resilient Lifelines
3. Framework for Roadmap and Recommended Topics
4. Recommended Research, Development and Implementation Priority Topics
 - ✓ Topic Summaries
 - ✓ Summary of Cost Estimates
5. Appendices (Describing Existing Resources)



Proposed Roadmap: 4 Program Elements / 28 Topics

- **Element I:** Establish national lifelines systems performance and restoration goals
- **Element II:** Develop lifeline system specific performance manuals, guidelines, standards, and codes
- **Element III:** Conduct problem focused research for various lifeline systems
- **Element IV:** Enable the adoption and implementation of lifeline system performance goals and standards

Topic Summaries Format

- **Title:** defines topic and scope
- **Description:** goals, objectives and tasks
- **Cost Category:** 4 broad ranges
- **Duration:** 2-3 yrs, 3-5 yrs, 5-8 yrs
- **Type of Endeavor:** defined in terms of personnel organizational structure
- **Potential Funding Sources:** govt., industry
- **Priority Ranking:** based on May 2014 workshop input

Program Element I: Establish National Lifelines Systems Performance and Restoration Goals

- Highest Priority Topics:
 - ✓ Develop an overarching framework for lifeline performance and restoration goals (Topic 1)
 - ✓ Establish procedures to quantify hazards over spatially distributed lifeline systems (Topic 3)
 - ✓ Develop tools to quantify and rank the societal benefits and costs of different lifeline system performance levels and restoration times, as well as, prioritize lifeline upgrades and investments (Topic 5)

Program Element II: Develop Lifeline System Performance Manuals, Guidelines, Standards, and Codes

- Highest Priority Topics:
 - ✓ Develop guidelines for the analysis, design, and planning of electric power infrastructure in seismically vulnerable regions (Topic 6)
 - ✓ Develop water system seismic guidelines and standards (Topic 8)
 - ✓ Develop wastewater system seismic guidelines and standards (Topic 9)
 - ✓ Develop guidelines for post-earthquake lifeline assessment, response, and recovery (Topic 13)

Program Element IV: Enable Adoption & Implementation of Lifeline Performance Goals & Standards

- Highest Priority Topics:
 - ✓ Develop tools, guidance, incentives and funding mechanisms for voluntary adoption and implementation of lifeline seismic resilience programs and earthquake-resilient design and construction standards (Topic 23)
 - ✓ Assess the direct and indirect socioeconomic consequences and financial implications of different lifeline performance levels and restoration timeframes (Topic 25)
 - ✓ Develop and deploy better tools, training and guidance for emergency operation planning, response, and restoration of lifeline systems (Topic 28)

Cost Estimates

<u>Program Element</u>	<u>Cost Range (\$millions)</u>
I. Establish National Lifeline System Performance and Restoration Goals (5 topics)	\$4.7 – 10.5
II. Develop Lifeline System Performance Manuals, Guidelines & Standards (10 topics)	\$6.4 – 13.0
III. Conduct Problem Focused Research for Various Lifeline Systems (7 topics)	\$7.5 – 17.0
IV. Enable the Adoption & Implementation of Lifeline System Performance Goals and Standards (6 topics)	\$6.2 – 14.5
TOTAL	\$24.8 – 55.0

Roadmap Implementation

Management Plan: Needs & Issues

- Lack of a lifelines umbrella organization is serious obstacle & potentially fatal flaw
- Need umbrella organization to set performance goals & standards & advocate for system enhancements
- Develop an organization that assures stewardship of U.S. national lifelines resilience
 - ✓ Independent non-profit organization
 - ✓ Program within an existing organization

Roadmap Implementation Management Plan: Options

- *Program within a larger organization*
 - ✓ American Lifelines Alliance (ALA)
 - ✓ Initially within ASCE/FEMA and then within NIBS/FEMA
 - ✓ 27 ALA projects with 6 incorporated into ANSI-accredited standards
 - ✓ Year-to-year funding not compatible with multi-year lifeline project needs
- *Independent nonprofit organization*
 - ✓ Executive Director with small full-time staff
 - ✓ Board of Directors to set policy and identify projects
 - ✓ Independent technical consultants engaged as needed
 - ✓ Utilization of a consensus-based approach for project/product development
 - ✓ Ability to expand/contract with available funding

Relevance for Multi-Hazards

- Lifelines essential for emergency response, restoration of order & recovery from earthquakes as well as other natural hazards and human threats
- Same characteristics affecting lifelines under earthquakes also affect them under other hazards: interdependencies, socio-economic, & institutional constraints
- Technologies to mitigate earthquake effects – network analysis procedures, advanced GIS, intelligent monitoring, & sensors – have multi-hazard applications
- An overarching performance framework for earthquake-resilient lifelines provides a blue print for developing the performance objectives of lifelines under multi-hazard conditions as well

Relevance for Multi-Hazards

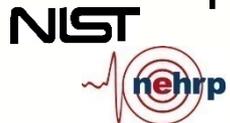
- Builds on the multidisciplinary culture that exists for earthquake preparedness with goals and specific priorities that are readily adaptable to other hazards
- Draws upon the long history of NEHRP agencies in funding and researching resilience of the built environment to earthquakes as well as other hazards, and in developing and publishing key guidance documents for lifeline earthquake performance
- Many topics have direct bearing on national priorities to promote resilience and improve interdependent lifeline performance under multi-hazard conditions and a critical part of an overall strategy and plan to support hazard-resilient communities

All Hazards Recommendations*

Defining Way Forward

- Framework and Vision for Lifeline EQ Resilience Be Adopted for All Hazards
- Research, Development, & Implementation Projects in the 4 Program Elements be Undertaken by NIST
- Expand the Program Elements to Include Other Hazards, Including Human Threats

*Separate informal recommendations to NIST



Earthquake-Resilient Lifelines: NEHRP Research, Development and Implementation
Roadmap: An Overview August 18, 2014 ACEHR Meeting, Golden, Colorado

