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Enhancing Energy Resiliency to Natural Disasters

Key Findings from Recent Natural Disasters

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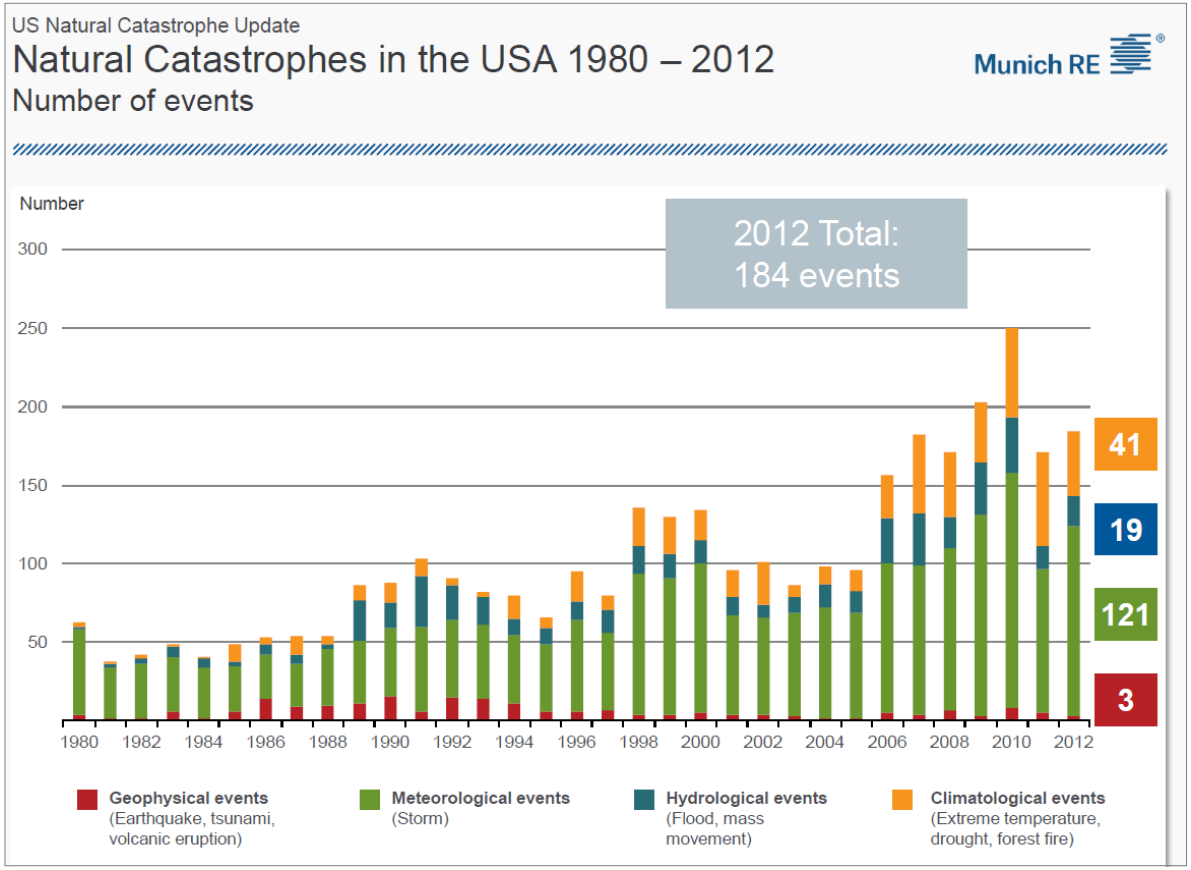
Background



- 2012 was the most active year in disasters in recent history, with more than 1,000 weather related fatalities, more than 8,000 injuries (source FEMA)
- Damages of natural disasters can lead to power outages ranging from hours to weeks before full restoration.
  - Sandy: 8M // ~14 days
  - Isabel: 6.5M // ~14 days
  - Irene: 6M // ~5 days

Program Description

- Establish a high impact, collaborative program to address energy sector R&D needs to enhance resilience to natural disasters
  - Initial Focus: 3-5 days before to 3-5 days after event
- Collect user-guided R&D requirements, needs, and gaps
- Develop a balance of short and medium term cost-effective solutions for transition to industry



Objective

- To understand the issues and operational challenges of the energy sector during natural disaster events such as hurricanes, and to improve resiliency of the energy infrastructure
- Identify gaps and areas to improve resiliency through efficiency, cost, or performance that require S&T to make effective operational changes and plans for preparing, responding and recovering from natural disasters
- Define how successful resilient solutions can be adopted and transitioned to end users for operations, recovery, and rebuilding

Approach

- Solicited industry participants to provide input
- Conducted series of one-on-one interviews with each to describe needs based on experience in the field
- Reviewed relevant reports
- Analyzed and consolidated all responses and information
- Held 1-day workshop
  - Discussed and validated/clarified the key findings
    - Reviewed key findings for completeness, accuracy, and clarification
  - Prioritized areas of interest
  - Provided specific requirements to top three areas of interest

Documents Reviewed

- Reviewed over 50 documents
- Several documents have additional references
- Examples
  - Northeast Gas Association – 2012 Mutual Aid Summit, Edison, NJ, Oct. 23, 2012
  - American Public Power Association – Post-Hurricane Sandy Report
  - Edison Electric Institute – Before and After the Storm
  - All Hazards Consortium – The Multi-State Fleet Response
  - Improving Electric Grid Reliability and Resilience: Lessons Learned from Superstorm Sandy and other Extreme Events. GRIDWISE Alliance
  - 2012 National Energy Assurance Planning Conference After-Action Report

Documents Reviewed

- Examples (cont'd)
  - Comparing the Impacts of Northeast Hurricanes on Energy Infrastructure. Office of Electricity Delivery and Energy Reliability, U.S. Department of Energy
  - Storm Response Reports – PepCo Holdings
  - Recommendations to Improve the Strength and Resilience of the Empire State's Infrastructure. NYS 2100 Commission
  - Washington, D.C. Blue Ribbon Task Force on Pepco Service Reliability
  - Powering America's Energy Resilience. The Center for National Policy
  - Hardening and Resiliency. U.S. Energy Industry Response to Recent Hurricane Seasons

Interviewees

- Electric Industry
  - National Rural Electric Cooperative Association (NRECA)
  - Edison Electric Institute (EEI)
  - American Public Power Association (APPA)
  - Electric Power Research Institute (EPRI)
  - GridWise Alliance
  - Consolidated Edison (ConEd)
  - PepCo Holdings
  - San Diego Gas and Electric
  - Florida Power and Light
  - Oncor
- Oil and Gas
  - Interstate Natural Gas Association of America
  - Consolidated Edison
  - Public Service Electric and Gas (PSE&G)
- State, Local, or Federal
  - National Association of State Energy Officials (NASEO)
  - Department of Energy – Office Of Electricity
  - Department of Homeland Security

Workshop Format

- A morning panel session discussed various utilities' experiences and perspectives on responding to natural disasters
- The participants were divided into two concurrent breakout sessions that allowed for in-depth exploration of the issues related to natural disasters
- Structured brainstorming and critical analysis was used to understand and clarify the key challenges. Each group had a facilitator that helped each group develop the top challenges
- At the end of the day, all participants reconvened in a summary session to report on the results of their breakout session discussions

Organization of Initial Challenges and Opportunities

- Organized along event timeline
  - Plan – > 1 year
  - Prepare – 1 to 5 days before event
  - Assess – 1 to 3 days after event
  - Restore – 1 to 5 days after event
  - Rebuild and enhance – After full recovery
- Organized by theme
  - Mitigation and system hardening
  - Operations and logistics
  - Modeling, simulation, and analysis
  - Communications

Challenges and Opportunities: Mitigation and System Hardening

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Plan

- Self-powered systems
  - PV powered stop lights
  - Use distributed energy resources to power neighborhoods
  - Use distribution automation equipment
- System hardening
  - Strengthen overhead poles or underground lines
  - Use flood protection and apply new standards
- Business models for resiliency
  - Develop cost benefit analysis
  - Describe non-financial benefits

Prepare

- Self-powered systems
  - Deliver generators to critical infrastructure
- Temporary Hardening
  - Turn off substations
  - Temporary flood protection

Restore

- Self-powered systems

Rebuild & Enhance

- Self-powered systems
- System hardening
- Business models for resiliency

Challenges and Opportunities: Operations and Logistics

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Plan

- Smart grid and advanced metering infrastructure
  - Reconfigurable distribution feeders
- Coordinate critical infrastructure interdependencies
- Understand and operationalize interdependencies

Prepare

- Pre-position resources: response teams and mutual aid
  - Travel, dedicated communications, lodging, meals equipment and supplies
  - Track progress
  - Mobile cell systems

Assess

- Rapid and accurate initial Estimated Time to Restore (ETR)
- Identify issues within and between critical infrastructures
  - Fuel delivery dependent on electric power – fuels stations, gas transmission

Restore

- Outage Management System
- Efficient restoration
- Distribution automation
- Fuel delivery and access

Challenges and Opportunities: Modeling, Planning and Analysis

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Plan

- Determine critical infrastructure and interdependencies
  - Energy, water, communications
  - Public health and safety
  - Prioritize
- Data integration
  - Energy system (AMI, transactions), social media, imagery in GIS view
- Advanced analytics
  - Detailed visibility into distribution system
- Model and simulate damage, response and recovery
- Plan for multi-scale events

Prepare

- Damage prediction – prepare accurate and actionable damage predictions
- Model and simulate response and recovery

Assess

- Damage assessment – rapid and accurate damage assessment
- Data and analysis for rapid and accurate initial ETR

Restore

- Data and analysis for timely, accurate, and granular ETR
- Model and simulate response and recovery
- GIS with information overlays

Rebuild & Enhance

- Justify investments in enhancing energy resiliency

Challenges and Opportunities: Communications

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Plan

- Coordinate across local and state Emergency Operations Centers
- Better disaster planning and exercises, including all hazards
- Establish key points of contact
  - Central fuel POC
  - Make personal connections
  - One POC for requesting utility
  - Well defined roles, responsibilities and expectations

Prepare, Assess and Restore

- Effective, efficient and frequent communications with stakeholders
  - Customers
  - Elected officials and media
  - Other Emergency Operations Centers
  - Types of communications

Workshop Breakout Session Priority Challenges

Real-time situational awareness, damage prediction and assessment

- Challenge
  - Full-time situational awareness to predict damage and improve pre-positioning of resources, and assess damage quickly, accurately, and safely
- Operational Requirements
  - Secure reliable communications
  - Integrate disparate data sources and share effectively with responders
  - Well defined faults
  - Accurate prediction of weather impact on assets
- Benefits
  - Reduce restoration time and cost – labor and materials
  - Enhance customer communication and relations
  - Improve accuracy of estimated time to restore (ETR)

Workshop Breakout Session Priority Challenges

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Communications

- Challenge
  - Minimize impact of losing communications during an event
- Operational Requirements
  - Redundant, dedicated, and prioritized signal able to reach all areas
  - Open and secure protocols
- Benefit
  - Improve damage assessment, outage analytics, resource optimization, reliability and better information to the public

Workshop Breakout Session Priority Challenges

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Data Analytics

- Challenge
  - Integrated deep data analytics to better support situational awareness and guide actions
- Operational Requirements
  - Integrated into existing systems
  - Automated and standardized plug and play tools
  - Consistent storage techniques
  - Effective polices and record retention
- Benefit
  - Reduce recovery time
  - Improve operations
  - Justify investments
  - Enhance customer satisfaction

Workshop Breakout Session Priority Challenges

Logistics

- Challenge
  - Understand interdependencies between energy sector and other critical infrastructure sectors and determine what cross-sector resources are available and/or needed before, during, and after an event
- Operational Requirements
  - Conduct a study to identify relationships between the various components of the energy sector supply chain – e.g., transportation, utilities, manufacturing, equipment, suppliers, cyber, finance
  - Use FEMA regions to organize the data
- Benefit
  - Minimize red tape so private industry can respond quickly and efficiently
  - Build better relationships among industries and local, state, and federal responders

Workshop Closing Comments

- Challenges are interrelated
- Manage expectations
- Reliable telecommunications
- Improve large data analytics and make usable operational tools
- Hardening and mitigation were not a identified as a priority challenge
  - Industry currently focusing on certain aspects
  - Other needs may be unmet by industry