Enhancing Energy Resiliency to Natural Disasters

Key Findings from Recent Natural Disasters

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September 10, 2013

Funded by the Department of Homeland Security Science & Technology Directorate
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
Reviewed over 50 documents

Several documents have additional references

Examples

- 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
Examples (cont’d)

- 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
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

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

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

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

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

Restore
- Outage Management System
- Efficient restoration
- Distribution automation
- Fuel delivery and access
Challenges and Opportunities: Modeling, Planning and Analysis

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

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

Prepare
- Damage prediction – prepare accurate and actionable damage predictions
- Model and simulate response and recovery
Challenges and Opportunities: Communications

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
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)
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
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 identified as a priority challenge
  - Industry currently focusing on certain aspects
  - Other needs may be unmet by industry