

PROTECTING THE NATION'S ENERGY INFRASTRUCTURE

Do you know your State's risks?

National Conference of State Legislators

Legislative Summit Taskforce on Energy Supply

Alice Lippert

Senior Technical
Advisor

Office of Electricity
Delivery and Energy
Reliability (OE)

US Department of
Energy

August 2, 2015



ENERGY INFRASTRUCTURE PROTECTION AND RISK ASSESSMENT

Protecting energy infrastructure requires:

- Knowing the specific threats and hazards affecting infrastructure to protect against
- Prioritizing resources available for infrastructure protection and resilience based on the likelihood of occurrence and potential consequences of threats and hazards

Risk assessment can help decision makers better understand threats, hazards, vulnerabilities, and consequences and make more informed decisions on how to best protect energy infrastructure and assets

STATE ENERGY RISK ASSESSMENT CONSIDERATIONS

- A growing awareness of the ever-emerging threats and hazards to energy systems and infrastructure
- The interdependent nature of energy and other lifeline infrastructures
- The complex challenge of information and data sharing and coordination among federal, state and local agencies, asset owners and operators, and the private sector
- Limited resources (staff, budget, and time) for development of risk assessment processes and capabilities at State level
- Improving States' understanding of risk assessment and energy system requirements and capabilities enables States to prepare for, mitigate against, respond to and recover from energy system disruptions.

STATE ENERGY RISK ASSESSMENT INITIATIVE AND STRATEGY

Key Goals and Objectives:

- Increase States' awareness of energy infrastructure risk considerations to better prepare them to make more informed decisions
- Provide a suite of scalable, easily-applied analytical tools, methods, and processes to enable States to better assess risks to energy systems and assets
- Objectives:
 - Determine State energy risk assessment needs
 - Assess current practices in State-level energy risk analysis
 - Engage with key stakeholders (across entire risk analysis development cycle) to enhance information sharing and collaboration

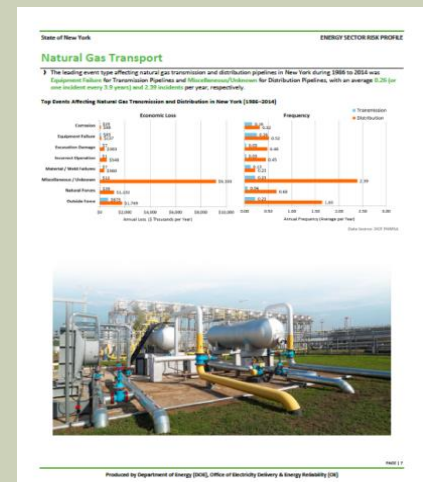
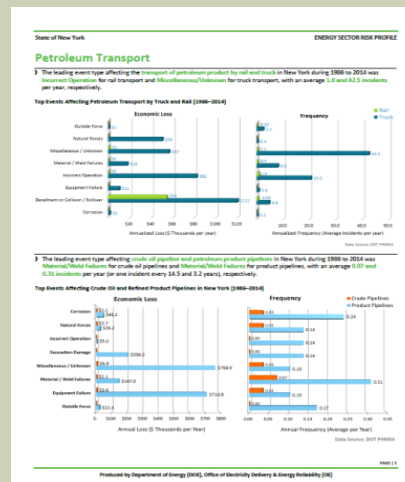
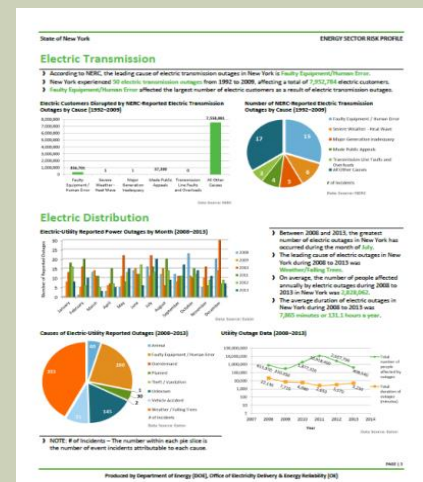
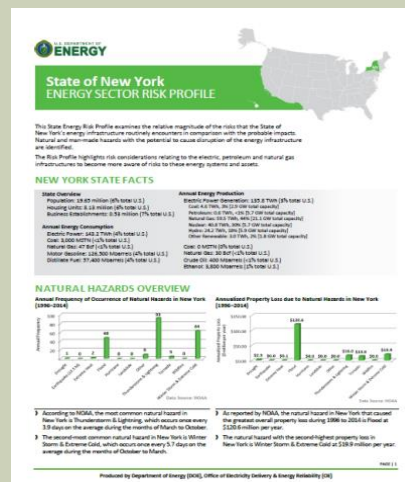
INITIATIVE ACCOMPLISHMENTS AND UPDATES

- **State Energy Risk Assessment Working Group**
 - Creation of a risk assessment and analysis taxonomy
 - Energy risk projections for the 2015 hurricane season
 - DOE- NASEO Webinar
 - NGA Threat Hazard Identification Risk Assessment (THIRA) Survey
 - Showed that many States have used THIRA but that more detailed risk assessment capabilities are also desired
 - Continued input/feedback on State risk assessment needs
- **State Energy Risk Profiles**
 - Profiles present most common threats and outages impacting energy infrastructure
 - Prepared for all 50 States and District of Columbia
- **State Energy Risk Assessment Workshop**
 - Denver, CO – April 28-29, 2015
- **Outreach to State Agencies and Association members**
 - Upcoming Summer and Fall Meetings

STATE ENERGY RISK PROFILES

Profiles include:

- Information on State energy facts
- Overview of hazards and economic property loss
- Causes of disruptions and outages by energy sector
- Infrastructure maps
- List of data sources and references used to create the profiles
- <http://www.energy.gov/oe/state-energy-risk-assessment-initiative-state-energy-risk-profiles>



WHAT NATURAL DISASTERS CAUSE THE MOST DAMAGE?

- Data from NOAA Storm Events Database analyzed for 1986 to 2014.
- Above ranking reflects the significance of extreme weather events, such as:

| Top-Five Natural Disasters and Weather Extremes by PADD (1986-2014) | | | | | |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Rank by Property Damage | PADD 1 (East Coast) | PADD 2 (Midwest) | PADD 3 (Gulf Coast) | PADD 4 (Rocky Mtns) | PADD 5 (West Coast) |
| 1 | Flood | Flood | Hurricane | Thunderstorm & Lightning | Wildfire |
| 2 | Hurricane | Thunderstorm & Lightning | Drought | Flood | Thunderstorm & Lightning |
| 3 | Tornado | Drought | Flood | Wildfire | Flood |
| 4 | Winter Storm & Extreme | Tornado | Thunderstorm & Lightning | Tornado | Winter Storm & Extreme |
| 5 | Thunderstorm & Lightning | Winter Storm & Extreme | Tornado | Winter Storm & Extreme | Earthquake |

- The New England Flood of October 1996 and Mid-Atlantic United States flood of 2006 (East Coast).
- The Great Flood of 1993 and the 2011 Mississippi River floods (Midwest).
- Hurricanes Ivan, Katrina, Rita, etc. in the Gulf Coast (Gulf Coast).
- Hail storms in Colorado and Wyoming (Rocky Mountains).
- California wildfires of October 2007 (West Coast).

WHAT HAZARDS POSE THE GREATEST THREATS TO THE ELECTRIC TRANSMISSION GRID?

- Each region appears to be vulnerable to different hazards.
- Greatest impact to the East Coast and Gulf Coast due to hurricanes.
- The Midwest is subject to extreme weather such as storm and high winds.
- Transmission line faults or overloads most-significant threat in the Rocky Mountains and Plains and West Coast, due to major transmission paths with high congestion.

| Top-Five Causes of NERC-Reported Electric Transmission Outages (1992 - 2009) | | | | | |
|--|------------------------------------|------------------------------------|--|--|--|
| Rank by Number of Customers | PADD 1 (East Coast) | PADD 2 (Midwest) | PADD 3 (Gulf Coast) | PADD 4 (Rocky Mtns) | PADD 5 (West Coast) |
| 1 | Hurricane / Tropical Storm | Thunderstorm | Hurricane / Tropical Storm | Transmission Line Faults and Overloads | Transmission Line Faults and Overloads |
| 2 | Complete Electrical System Failure | Complete Electrical System Failure | Thunderstorm | Fuel Supply Deficiency | High Winds |
| 3 | Ice Storm | Winter Storm | Faulty Equipment / Human Error | Faulty Equipment / Human Error | Thunderstorm |
| 4 | Thunderstorm | Ice Storm | Transmission Line Faults and Overloads | Unknown Cause | Faulty Equipment / Human Error |
| 5 | High Winds | High Winds | Heat Wave | Physical Impact / Attack | Heat Wave |

WHAT ARE THE MAJOR THREATS TO ELECTRIC DISTRIBUTION?

- 90% of customer outage-minutes are due to events which affect local distribution systems.
- Weather are the predominating events for East and Gulf Coasts
- In the Midwest, most power outages are caused by damage from trees.

| Rank by Number of Incidents | PADD 1 (East Coast) | PADD 2 (Midwest) | PADD 3 (Gulf Coast) | PADD 4 (Rocky Mtns) | PADD 5 (West Coast) |
|-----------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 1 | Weather / Falling Trees | Weather / Falling Trees | Weather / Falling Trees | Faulty Equipment / Human Error | Faulty Equipment / Human Error |
| 2 | Faulty Equipment / Human Error | Faulty Equipment / Human Error | Faulty Equipment / Human Error | Weather / Falling Trees | Weather / Falling Trees |
| 3 | Unknown | Unknown | Unknown | Unknown | Unknown |
| 4 | Vehicle Accident | Animal | Vehicle Accident | Vehicle Accident | Vehicle Accident |
| 5 | Animal | Vehicle Accident | Animal | Animal | Planned Outage |

- Faulty equipment / human error tops the list for the Rocky Mountain and West Coast regions.
- “Unknown” events include those with “multiple initiating” causes.
- Outages are also caused by vehicles accidents.

WHAT ARE THE MAJOR THREATS TO PETROLEUM TRANSPORT?

Top-Five Causes of Major Rail and Truck Incidents Involving Crude Oil and Petroleum Transport by PADD (1971 - 2014)

| Rank by Economic Loss | PADD 1 (East Coast) | PADD 2 (Midwest) | PADD 3 (Gulf Coast) | PADD 4 (Rocky Mtns) | PADD 5 (West Coast) |
|-----------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | Collision / Rollover | Collision / Rollover | Collision / Rollover | Collision / Rollover | Collision / Rollover |
| 2 | Miscellaneous / Unknown | Miscellaneous / Unknown | Miscellaneous / Unknown | Miscellaneous / Unknown | Miscellaneous / Unknown |
| 3 | Natural Forces | Natural Forces | Natural Forces | Incorrect Operation | Natural Forces |
| 4 | Incorrect Operation | Incorrect Operation | Incorrect Operation | Natural Forces | Incorrect Operation |
| 5 | Material / Weld Failures | Material / Weld Failures | Material / Weld Failures | Material / Weld Failures | Material / Weld Failures |

- Collision / Rollover is a vehicle accident in which a vehicle tips over onto its side or roof.
- Miscellaneous / Unknown denotes incidents in which the cause is unknown or has multiple causes (e.g., Incorrect Operation and Corrosion).

- Outside Force damage results from some external force such as excavation activities (“third-party” damage).
- Natural Force Damage occurs as a result of naturally occurring events such as flooding, earthquakes, and lightning.

Top-Five Causes of Major Incidents Involving Crude and Petroleum Pipelines by PADD (1986 - 2014)

| Rank by Economic Loss | PADD 1 (East Coast) | PADD 2 (Midwest) | PADD 3 (Gulf Coast) | PADD 4 (Rocky Mtns) | PADD 5 (West Coast) |
|-----------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | Corrosion | Material / Weld Failures | Outside Force | Natural Forces | Outside Force |
| 2 | Outside Force | Corrosion | Corrosion | Outside Force | Miscellaneous / Unknown |
| 3 | Material / Weld Failures | Outside Force | Natural Forces | Corrosion | Corrosion |
| 4 | Miscellaneous / Unknown | Miscellaneous / Unknown | Material / Weld Failures | Incorrect Operation | Incorrect Operation |
| 5 | Equipment Failure | Incorrect Operation | Miscellaneous / Unknown | Material / Weld Failures | Material / Weld Failures |

CAUSES OF PETROLEUM REFINERY DISRUPTIONS

| Top-Five Causes of Petroleum Refinery Outages by PADD (2003 - 2014) | | | | | |
|---|---|--------------------------------------|--------------------------------------|---|---|
| Rank by Number of Incidents | PADD 1 (East Coast) | PADD 2 (Midwest) | PADD 3 (Gulf Coast) | PADD 4 (Rocky Mtns) | PADD 5 (West Coast) |
| 1 | Equipment Failure or Damage | Maintenance / Turnaround | Equipment Failure or Damage | Fire and/or Explosion | Maintenance / Turnaround |
| 2 | Maintenance / Turnaround | Equipment Failure or Damage | Operational Upset or Process Problem | Maintenance / Turnaround | Operational Upset or Process Problem |
| 3 | Operational Upset or Process Problem | Operational Upset or Process Problem | Maintenance / Turnaround | Loss of Electric Power or Other Utility Service | Equipment Failure or Damage |
| 4 | Loss of Electric Power or Other Utility Service | Cause Not Specified | Loss of Containment / Flaring | Equipment Failure or Damage | Loss of Containment / Flaring |
| 5 | Cause Not Specified | Fire and/or Explosion | Cause Not Specified | Cause Not Specified | Loss of Electric Power or Other Utility Service |

- Similar causes for petroleum refinery disruption observed throughout the U.S.
- The U.S. Gulf Coast has some of the world's most sophisticated refineries – contains much equipment that can fail
- A turnaround is a planned break in production so that maintenance may be performed - most refineries go through a turnaround every three to five years

WHAT ARE THE MAJOR THREATS TO NATURAL GAS TRANSPORT?

| Top-Five Causes of Major Incidents Involving Natural Gas Distribution and Transmission Pipelines by PADD (1984 - 2014) | | | | | |
|--|--------------------------|-------------------------|--------------------------|--------------------------|--------------------------|
| Rank by Economic Loss | PADD 1 (East Coast) | PADD 2 (Midwest) | PADD 3 (Gulf Coast) | PADD 4 (Rocky Mtns) | PADD 5 (West Coast) |
| 1 | Miscellaneous / Unknown | Outside Force | Outside Force | Outside Force | Material / Weld Failures |
| 2 | Outside Force | Miscellaneous / Unknown | Natural Forces | Miscellaneous / Unknown | Outside Force |
| 3 | Natural Forces | Natural Forces | Miscellaneous / Unknown | Natural Forces | Miscellaneous / Unknown |
| 4 | Corrosion | Corrosion | Corrosion | Material / Weld Failures | Natural Forces |
| 5 | Material / Weld Failures | Incorrect Operation | Material / Weld Failures | Equipment Failure | Corrosion |

- Outside Force damage is generally the primary cause of disruption to the natural gas pipeline network.
- Natural Forces such as flooding and lightning is also a major cause.
- Corrosion of natural gas pipelines is less of a concern compared with petroleum pipelines.

STATE ENERGY RISK ASSESSMENT WORKSHOP

Held April 2015 in Denver, CO

Topics Covered:

- Risk frameworks and approaches
- Methods for predicting electrical outages and analyzing petroleum data
- Grid threats and cyber-security considerations
- Demonstrations of “best of breed” risk assessment tools and methods available for States and localities
- Federal risk assessment tools such as DHS’ Threat and Hazard Identification and Risk Assessment (THIRA) and the Regional Resiliency Assessment Program (RRAP)
- Facilitated open discussion among attendees regarding needs and challenges for State-level energy risk assessment

STATE ENERGY RISK ASSESSMENT WORKSHOP

Key Takeaways:

- Better detail, resolution, and access to data, definitions, and tools is needed
- Better collaboration and information sharing is needed
- Resources are scarce with which to implement risk assessment
- More case studies and real-world examples are needed
- More risk assessment education and training opportunities are needed
- Greater communication of risk between stakeholders and decision makers and the public is needed
- <http://www.naseo.org/risk-assessment-workshop>

NEXT STEPS

- Organize additional webinars and presentations for State Energy Risk Assessment Working Group and N-group members
- Provide additional risk assessment resources and information to stakeholders based on feedback provided at workshop
- Develop a Risk Tool Kit
- Engage energy infrastructure decision makers more directly and help facilitate risk communications among policy makers, State energy offices, utility commissions, and emergency management/homeland security agencies.
- Continued engagement with respective energy infrastructure stakeholders

RISK CONSIDERATIONS FOR STATES

- What are the biggest challenges to protecting energy infrastructure in your State?
- What infrastructure issues are of highest priority in your State?
 - How was it determined to make them high priority?
- How has risk assessment been utilized in your State?
- Is consideration of risk used when making decisions on energy infrastructure protection and resilience in your State?
- What would be most helpful to legislators, in your State, to increase awareness of risk assessment considerations relating to energy infrastructure?

THANK YOU!

Alice Lippert, DOE/OE
Alice.Lippert@hq.doe.gov

