Energy & Technologies Committee
Hearing, September 26, 2011
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Senator Fonfara, Representative Nardello, Joint Committee Members and Staff, good afternoon. My name is Joel Gordes and I am an independent energy consultant representing myself. I appreciate the opportunity to provide comments on Storm Irene[1] and what I believe must be done to add resiliency to the grid to meet numerous vulnerabilities, not just storms, in a holistic manner. A summary of my comments includes:

- The grid evolved into a complex system subject to stress, natural hazards, physical & cyber attacks
- "Distributed Generation" (DG) and "Decentralization" can enhance resiliency
- Smart Grid is promising but has its own security-based challenges
- Legislation/regulation needs to become holistic and drive resiliency via rewards in utility ROR

The Edison Model of an Electric Grid might today be called a "microgrid" defined as "... power systems in which generation elements are co-located with loads, regardless of the aggregated generation capacity or the grid interconnection."[2] He also used direct current which could only travel about 1.5 miles with generators so inefficient that the power cost in today's dollars would cost over $6.00/kWh.

How Did Regulated Monopolies Emerge – Tesla and Westinghouse

- Larger, efficient AC generators having economies of scale were required to lower cost to consumers
- Power executives, manufacturers and bankers lobbied for monopolies & accepted obligation to serve
- Further distances of generators from loads drove grid architecture to require transmission lines
- It resulted in industrial growth of goods and services and overall greater freedom
- Greater profits for electricity providers
- Obvious and hidden vulnerabilities due to transmission that sets the grid architecture emerged. On this point, many utility executives may disagree but the prestigious **National Science Council has warned**:

> A direct way to address vulnerable transmission bottlenecks and make the grid more robust is to build additional transmission capacity, but there are indications that redundancy has a dark side... The likelihood of hidden failures in any large-scale system increases as the number of components increases.[3]

Not the Trees Alone: What Are the Security Threats? (As Opposed to RAM, Sufficiency, etc.?)

- Fuel supply interruption/cost escalation
- Physical security of generation, transmission, distribution, Control Technology (SCADA)
- Foreign dependency via disruption of globalized supply chains for critical grid components (GSUs, etc.)
- Cyberthreats including distributed denial of service, hacking, electromagnetic pulse (including coronal mass ejections), embedded codes in foreign sourced components and weaknesses in SCADA/IPC
- A combined or "blended" combination of the aforementioned threats
- Other threats and considerations including "unintended consequences" of other actions

Distributed Resources. New technologies that lessen dependence on economies of scale to be efficient are available as building blocks for new microgrids. Often misunderstood, a composite definition is:

> Distributed resources include conservation and load management with modular electric generation and/or storage located near the point of use either on the demand or supply side. DR includes fuel-diverse fossil and renewable energy generation and can either be grid-connected or operate independently. Distributed resources typically range from under a kilowatt up to 50 MW.[4]

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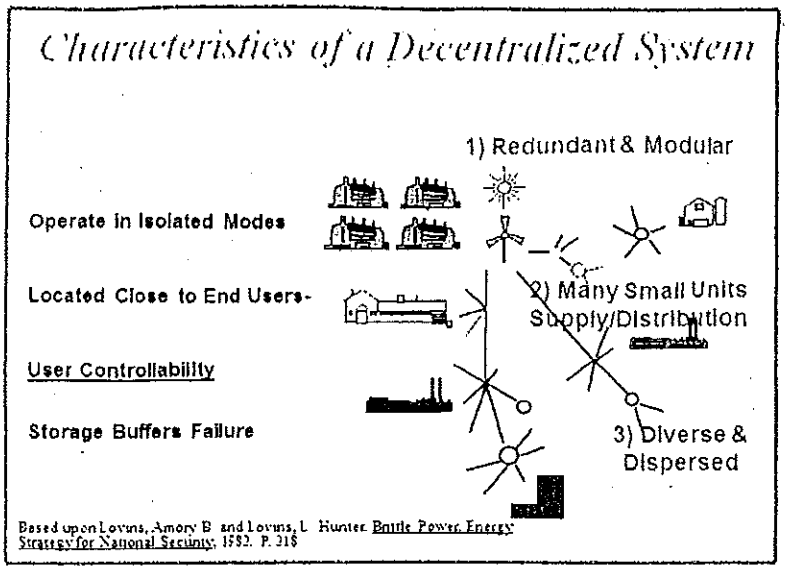
[1] Limited comments specific to Tropical Storm Irene appear on page 3 of this document.
[2] Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson. *Facility Microgrids.* NREL. May 2005.
[3] Making the Nation Safer: The Role of Science and Technology in Countering Terrorism. National Academy Press. p.302. June 2002
[4] Composite definition of US DOE(2), EPRI(2), CEC(1), AGA(1). The term "Distributed Generation" has been credited to Dr. Carl Weinberg (former Research Director at Pacific Gas & Electric) and his group.

Some Forms of Distributed Resources/Distributed Generation

Efficiency | Fuel Cells | Solar PV | Microturbines | Some Windpower

Decentralization for Resiliency[5] Employs Distributed Generation (DG) That Can "Island"



Enter the Promise of Smart Grid[6]

- Improved reliability, security [maybe not] and efficiency through digital control technology
- Optimization of grid operation
- Easier interconnection of distributed resources and end use smart appliances
- Control of demand response down to the consumer appliance level
- Provision for storage technology including plug-in hybrid electric vehicles and all-electric vehicles
- Real time information on electric pricing for transactive procurement of power
- Requires overcoming barriers to adoption of Smart Grid technologies
- Requires standards/security provisions for communications and interoperability of connected device

Short and Long Term Recommendations

- Fully implement PA 07-242 Secs. 51-52 to obtain All Achievable Conservation/Load Management
- Plan Energy Resiliency into High Value Applications (hospitals, first responders, gasoline stations, telecom, sewage plants) by use of distributed generation including combined heat and power
- Provide Rates of Return for Utility Actions Favoring Resiliency (Use Decoupling/Other Mechanisms)
- Provide Incentives for DG, combined heat and power to utility & private sector players
- Implement a Long Term Plan Incrementally but With Annual Targets
- Minimize Transmission Projects and Investments to Avoid Locking Out Other Options
- Apply for DHS and Other Federal Funding to Implement Resiliency
- Make Insurers Partners to Reduce Their Losses and Contribute Their Expertise –and Funding

[5] Lovins, Amory and L. Hunter. *Brittle Power*. Brick Housing Publishing. 1982. pp. 215-219.
[6] ISO-NE. Overview of the Smart Grid Policies, Initiatives, and Needs. February 17, 2009. pp. 2-3

Comments Specific to the Preparation, Response and Recovery from Tropical Storm Irene

- This was a tropical storm, not a hurricane, but due to its relatively slow forward motion inflicted significant damage on the state's electric power infrastructure leaving more people out of power than any incident to date. One has to wonder what the result would be from a more intense storm.
- Preliminary assessments indicate lack of sufficient tree trimming may have played a major role BUT, like some many other actions, even tree trimming has a diminishing return and any plan to add true resiliency to the grid cannot begin and end with this one action. A solution to storm threats may actually exacerbate damage from other threats if not treated in a holistic manner.
- Some mission critical facilities were not able to operate due to loss of power and failure of back ups
- Similar facilities had experienced such failures in the past
- Communications to local officials and others could have been better

Two previous dockets both have some relevance to the issues at hand. These came from Public Act 07-242, An Act Concerning Electric and Energy Efficiency, a 200+ page bill. It had two sections that pertain either to electric reliability or energy security. I will very briefly address them here and provide further sources:

1) In Section 5 of the legislation, it mandated a study of electric system efficiency and response which was addressed in DPUC Docket 07-06-63 which was titled **DPUC Report to Connecticut General Assembly on Electric Distribution Company Staffing Levels, Public Notification Processes, and Service Restoration Response Time Relating to Electric Service Outages**. It was introduced by Rep. George Wilbur of Colebrook, Connecticut due to the many as the lengthy outages that took place in his district in the more severe weather regime of NW Connecticut. While I did not directly participate in the docket, at the request of a Colebrook official, I did make some comments on a copy of the final decision which identified some deficiencies (such as staffing levels for recovery) but which was inconsistent in this same section on page 8 . (The decision with my annotations may be accessed at http://www.box.net/files/0/item/f_940387528) Parts of the decision take the word of the utility on some operational activities such as having consolidated offices to reduce cost having no effect on recovery activities but there is no third party substantiation of this AND the Department actually said it believes this contributed to "adversely affect response to outages and emergencies" but issued no order but only citing it did provide cost reduction. I noted at the time this set up a dual standard where one set of customers was "more equal" than others in the obligation to serve. Obviously, getting power back to the greatest number of people and critical facilities is in the public interest BUT those who are served by a lesser standard should maybe be considered for some rate relief.

2) Also in the 07-242 legislation was **Implementation of Section 8 and Section 54 of Public Act No. 07-242 An Act Concerning Electricity and Energy Efficiency.** This fell under the CT Siting Council (CSC) which established Docket #346 on Energy Security (See http://www.ct.gov/csc/cwp/view.asp?a=962&q=396892) which I did enter as an intervener under "Environmental Energy Solutions" or "EES" on a pro bono basis. Let me just say that I was extremely disappointed with the CT Siting Council's approach to this since resilience begins at the siting level when one looks at energy security in a holistic way. The electric grid, as noted earlier, is a complex system, and cannot be approached merely in a piecemeal manner but must be treated as a system and consider what the effect of adding one component or another does to the overall complexity and vulnerability of that system. In addition, this General Assembly had previously given a directive as far back as Public Act 03-140 for the CSC "to promote energy security" --a very important point—since by the time of this docket six years had elapsed. While the legislature had not provided much direction, CSC had not taken any initiative to so much as define what they understood "energy security" to mean. Docket #346 went on to say that CSC would not consider "natural disasters" to fall under security in spite of a motion made to specifically include that in order to be consistent with a document on security by a Presidential Decision Directive from 1998 that the CSC itself cited.

Some far better defined direction needs to be provided to this agency so they may more adequately meet their mandates. It should be made clear that the gnashing of teeth and protesting that they are an "environmental organization" should not be accepted or, if it is, incorporate them into DEEP without hesitation, something I would be sorry to see since many of the disciplines and mechanisms found in nature have direct application to aspects of energy security.