

ISRCS 2008

Resiliency Requirements: More than Reliability

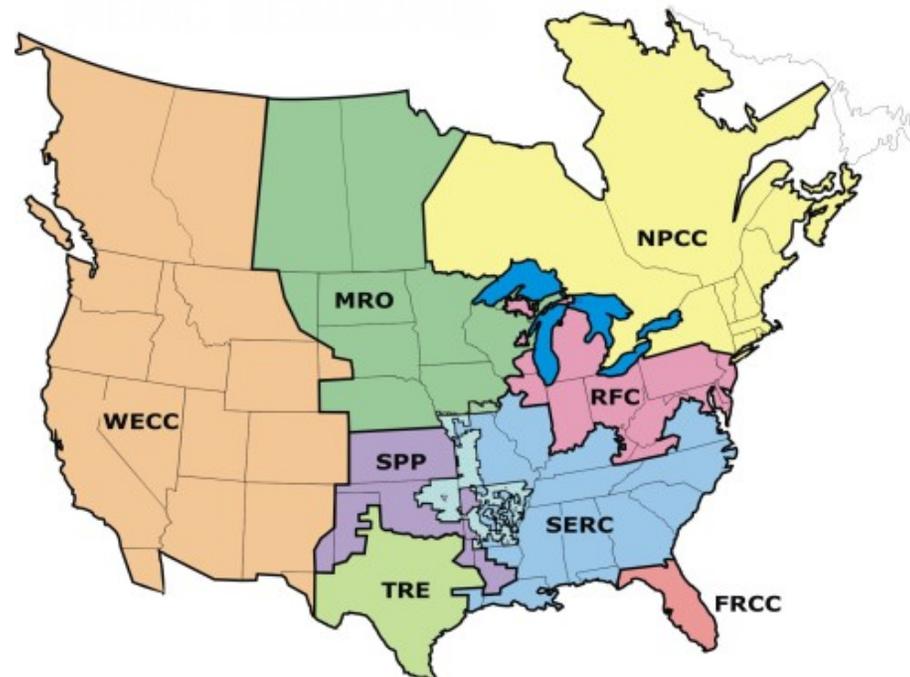


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What is Reliability?

- ❖ Ability
- ❖ To perform and maintain functions
- ❖ In routine, hostile, or unexpected circumstances

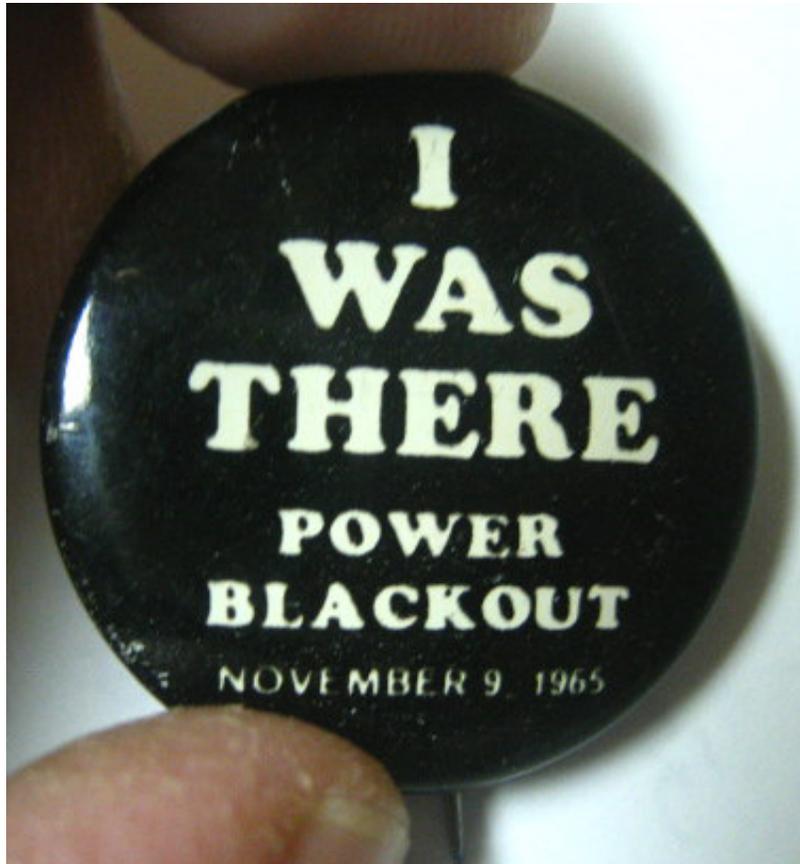


What is Resiliency?

- ❖ The ability to:
 - Quickly Adapt
 - Quickly Recover
 - Minimize Impactto Change or Misfortune (be it manmade, terrorist, or natural)



The First Warning NE Blackout of 1965



- ❖ Financial Loss > \$135M
- ❖ Not Widespread
- ❖ Human Error at 1 Protective Relay
- ❖ System Wasn't "Smart Enough" to Partition
- ❖ Power Resupply Uneven
- ❖ Forced Americans to Rethink Dependence
- ❖ Resulted in First Steps Toward Reliability

Was the System Resilient or Reliable? **ISRCS 2008**

The Cleveland Blackout of 2003

- ❖ Largest in North American History
- ❖ Financial Losses >\$6B
- ❖ Vegetation Management and Human decision making were key factors
 - 50 million people across the Northeast U.S. and Southeast Canada lost power
- ❖ Took more than 5 days for most operations to return
- ❖ National Security was Threatened



Answer

RELIABLE

- ❖ Power quality was good
- ❖ Some entities had back-up power



RESILIENT

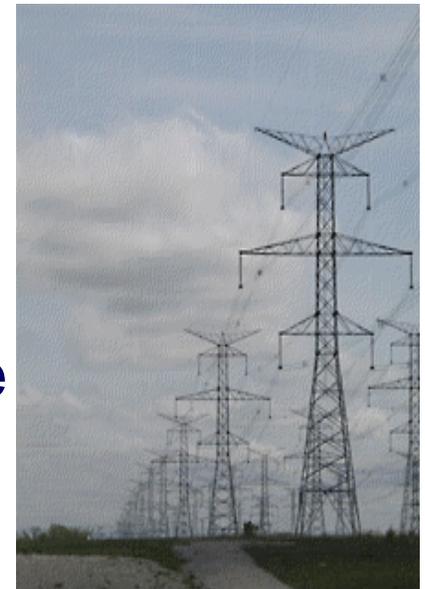
- ❖ Long time to restart
- ❖ Everything impacted

Unable to quickly adapt and recover!



What About Brownouts?

- ❖ Reduction in Voltage in Power Line
- ❖ Very Common
 - Heavy load periods
 - During storms
 - Mechanical failures in adjacent areas
- ❖ Effects
 - Can damage and shorten equipment life
 - Decrease safety
 - Increase financial impact
- ❖ Provides Some Resiliency



Energy Infrastructure

Underpins All Other Infrastructures

Energy-Dependent Sectors

- ❖ Information
- ❖ Telecommunication
- ❖ Transportation
- ❖ Banking and Finance
- ❖ Manufacturing and Chemical Processing

Essential Services

- ❖ Food
- ❖ Water
- ❖ Public Health
- ❖ Postal Service

But it's a 2-way street: *“The dependence of major infrastructural systems on the continued supply of electrical energy, and of oil and gas, is well recognized.”*

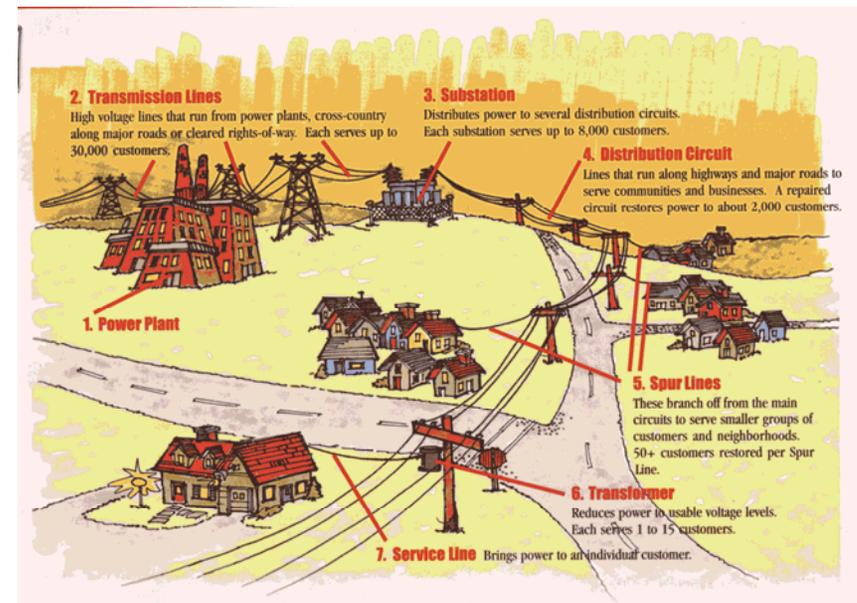
Most Critical Infrastructure

❖ Over 80% of the energy infrastructure is privately owned

- Investor-owned utilities (IOUs) =73 percent of the transmission lines
- Public utilities and cooperatives=14 percent
- Federally owned utilities=13 percent

❖ Competing priorities

- Meeting Current Needs
- Safety (Aging)
- Quality
- Expansion
- Security
- Profit



NERC Enforces Compliance with Electric Reliability Standards, Reliability Improvements Underway

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- ❖ June 4, 2008 — The North American Electric Reliability Corporation (NERC)
- ❖ Submitted the first set of violation notices to FERC.
- ❖ Include a number of violations
 - Majority are documentation related and do not include a financial penalty.
 - Improper Vegetation Management on transmission lines include \$225k penalty

What About Infrastructure Resiliency?

- ❖ Major Area of Focus (9/11)
 - National Defense
 - Law Enforcement
- ❖ Technological Additions to Existing Infrastructures
 - Detect adverse agents
 - Enhance cyber protection
 - Facilitate interoperability among first responders
- ❖ Masks Decline in Overall Resiliency



Resiliency Challenge!

- ❖ Need to Address Whole System
- ❖ Proactive vs Reactive
- ❖ Robust
- ❖ Affordable
- ❖ Quick/Graceful Recovery
- ❖ Key Vulnerabilities and Interdependencies
- ❖ Series of smart systems to predict and “heal”



Long-term goal – Automatic, Smart, Reconfigurable, And Secure Electric Infrastructure

And It Must Be AFFORDABLE!!!

Questions? Answers!



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