

PREPTalks

New perspectives for emergency managers



CENTER FOR HOMELAND
DEFENSE AND SECURITY
NAVAL POSTGRADUATE SCHOOL

Left in the Dark:
Power Outages in an Interconnected World

Kate Konschnik

Agenda

Agenda

Introductions (5 minutes)

Watch the PrepTalks (20 minutes)

Discussion (30 minutes)

Introduction



- Kate Konschnik directs the Climate & Energy Program at the Nicholas Institute for Environmental Policy Solutions at Duke University and is a Senior Lecturing Fellow at Duke Law School
- Kate's research focuses on policy options for public electric utility regulation and electricity market reforms to accommodate new technologies, electrification of other sectors, and air quality and decarbonization goals

Watch the PrepTalk

<https://www.fema.gov/blog/preptalks-kate-konschnik-left-dark-power-outages-interconnected-world>

Topics

- The Fundamentals of Electricity
- Vulnerabilities and Power Outages

Topic 1: The Fundamentals of Electricity

- Electricity is instantaneously conducted through wires from generating facilities to wherever it is needed

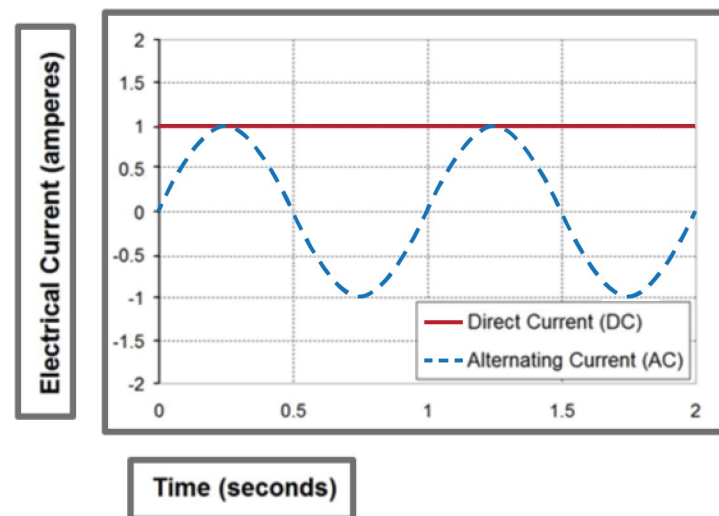


<p>1 Generating Station Electricity is typically generated by a steam- or hydro-driven turbine at the power plant.</p>	<p>2 Step-Up Transformer The power is then ramped up to high voltage for long-distance transmission.</p>	<p>3 Transmission Next, a series of high voltage lines transmit the electricity through the power grid.</p>	<p>4 Step-Down Transformer Power is then reduced to a lower voltage for use in homes and businesses.</p>	<p>5 Subtransmission Customer The electricity then passes through a series of switches to distribution lines.</p>	<p>6 Customers Power is then delivered to customers via local lines.</p>
--	--	---	--	---	--

CREDIT: NYISO

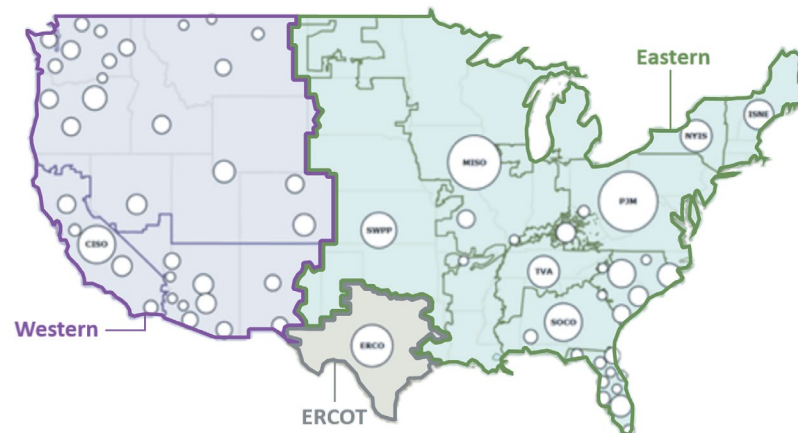
Topic 1: The Fundamentals of Electricity

- Thousands of facilities generate electricity in the United States
- Electricity is conducted through wires from generating facilities to wherever it is needed.
- Carrying capacity of the line is measured in megawatts:
 - Voltage of line (the pressure the line can take)
 - Distance needed to travel
- American power lines conduct alternating current
 - The current switches direction as it travels (from positive to negative)
 - One cycle is one Hertz
- The frequency of the switching must be kept relatively constant for the system to work



Topic 1: The Fundamentals of Electricity

- US Electric Power Regions (Interconnections)
 - Interconnections are managed through balancing authorities: public and private utilities and competitive electricity markets



Source: U.S. Energy Information Administration

“The grid” is a hodgepodge of overlapping physical and regulatory structures working in uneasy alliance to deliver power in real time.

– Kate Konschnik

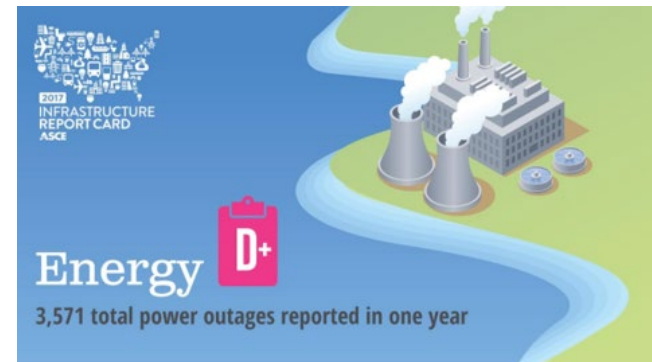
Topic 1: The Fundamentals of Electricity



1. Who are the electricity providers in your community?
2. Where are the generating stations that serve your community located? Where are the substations, which convert high voltage to low voltage? Are they located in areas that could be affected by flooding, wildfires, or other hazards?
3. Are electric utilities part of your planning teams? Do they participate in your exercises?
4. Are there other sources of power in your community (e.g., a significant presence of solar on homes or business; wind farms; hydroelectric dams)?

Topic 2: Vulnerabilities and Power Outages

- The American Society of Civil Engineers' Infrastructure Report Card assessed the Energy Sector as a D+ and reported 3,571 power outages in one year
 - Most U.S. power lines were built in the 1950s and 1960s
 - When built, they had an expected life of 50 years
- On any given day, about a half million people in the U.S. lose power for two hours or more



Today, we are taxing this system because we are moving towards more distributed and more variable generation and we are experiencing multi-directional current. As we plug more of our lives into this complex grid, we become that much more reliant on this energy source and, potentially, more vulnerable.

– Kate Konschnik

Topic 2: Vulnerabilities and Power Outages

Causes of Power Outages

- Storms:
 - High winds knock out power lines
 - Storm-caused flooding of power plants
 - Ice buildup weighs down power lines
- Trees coming in contact with power lines:
 - Falling trees or limbs from high winds
 - High temperature cause lines to sag and connect with trees
- Cyber:
 - Faulty code
 - Human error
 - Cyberattacks or hacking
- Other hazards: earthquakes, system overloading, brownouts, frozen piles of coal

Consequences of Power Outages

- Loss of:
 - Heating and cooling systems
 - Water systems
 - Food refrigeration
 - Medicine refrigeration
 - Medical equipment
 - Fuel
 - Communications
 - Money/ATMs
- Stores closed or limited operations
- Traffic control issues
- Security concerns
- Danger from downed power lines

Topic 2: Vulnerabilities and Power Outages

- Mitigation
- Storm Hardening Programs
 - Replacing wooden poles with concrete
 - Burying lines
 - Tree trimming
- Technology Solutions
 - Smart Meters
 - Self-Healing Grids

States may need to revisit how they think about cost-benefit allocations. For instance, most states don't consider the lost economic productivity caused by a blackout. If they did more of these, [mitigation] programs might start to make sense.

– Kate Konschnik

Topic 2: Vulnerabilities and Power Outages



1. How did the example of Ocracoke make you think about a prolonged power outage in your community?
2. What is the history of power outages in your area? What was the cause of these outages? What was the consequence? What went well and what could have been improved?
3. Are there plans in place to mitigate power outages in your community? What is the process to approve funding proposals?
4. How is your emergency management team preparing for an extended power outage? Have you conducted exercises to test how you would operate without power? How can you be more strategic now to ensure basic community functions during a prolonged power outage?

Discussion of Next Steps

- Establish relationships with utility companies
- Conduct community outreach to educate the community on the impact of an extended power outage
- Identify analog backups for community functions and strategic priorities for generators and other alternative energy sources
- Pre-determine solar powered nano-grid zones to serve community needs
- Conduct exercises without power
- Coordinate with amateur radio groups to ensure communication capabilities
- Identify low-tech solutions: laminated paper maps, solar-charged lanterns and USB ports, wheelbarrows



PrepTalks. New Perspectives for Emergency Managers.

PREPTalks
New perspectives for emergency managers

www.fema.gov/preptalks