

A presentation from the 2009 Topical Symposium:

***Energy Security: A Global Challenge***

Hosted by:  
The Institute for National Strategic Studies  
of  
The National Defense University

29-30 September 2009

By  
**SCOTT PUGH**

**INSS**



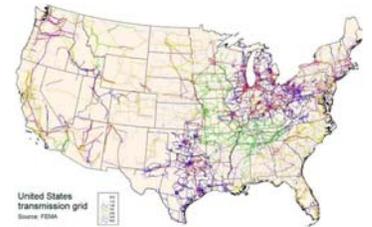
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# Secure Grid 2009

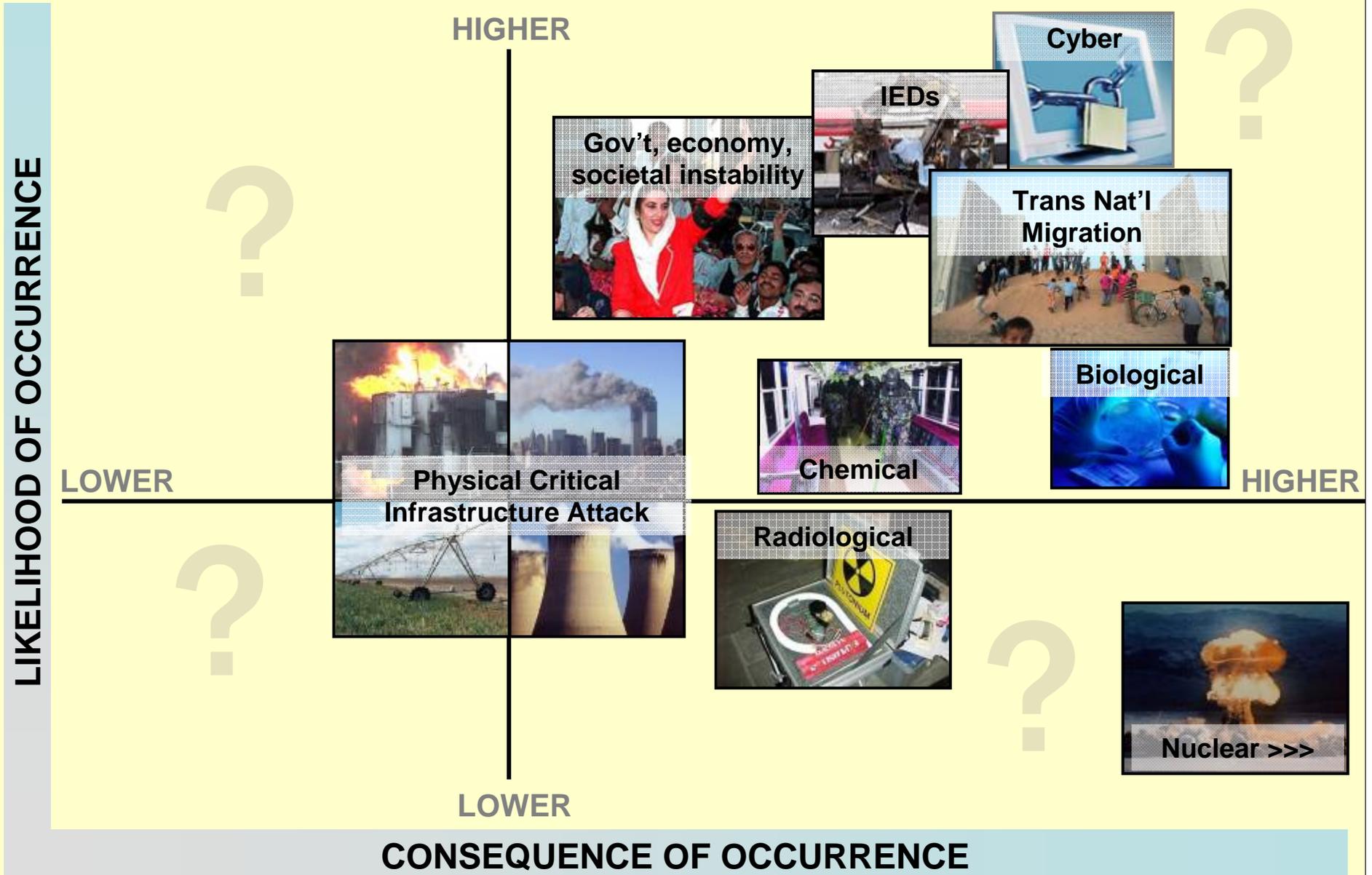
## A DHS-DOE-DOD Joint Exercise

### 9 & 10 July 09



*Hosted by National Defense University*

# POSSIBLE TERRORIST ROADMAP



**BOMBS, BORDERS, BUGS, BUSINESS, *BODIES & BUILDINGS***

# Summarizing Energy Security

## Fossil Fuels

- Oil
- Coal
- Gas

## Nuclear

## Renewables

- Hydro
- Wind
- Solar
- Geothermal
- Ocean Energy
- Biomass
- Biofuels



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# Summarizing Energy Security

**Electricity**

*Fossils  
Nuclear  
Renewables*

**Oil**



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# A DOD, DOE, DHS Joint Concern

**“Critical national security and Homeland defense missions are at an unacceptably high risk of extended outage from failure of the grid.”**

*Dependence on a vulnerable commercial power grid may be a bigger risk to DOD than dependence on oil.*

*Report of the  
Defense Science Board Task Force  
on  
DoD Energy Strategy  
“More Fight – Less Fuel”*



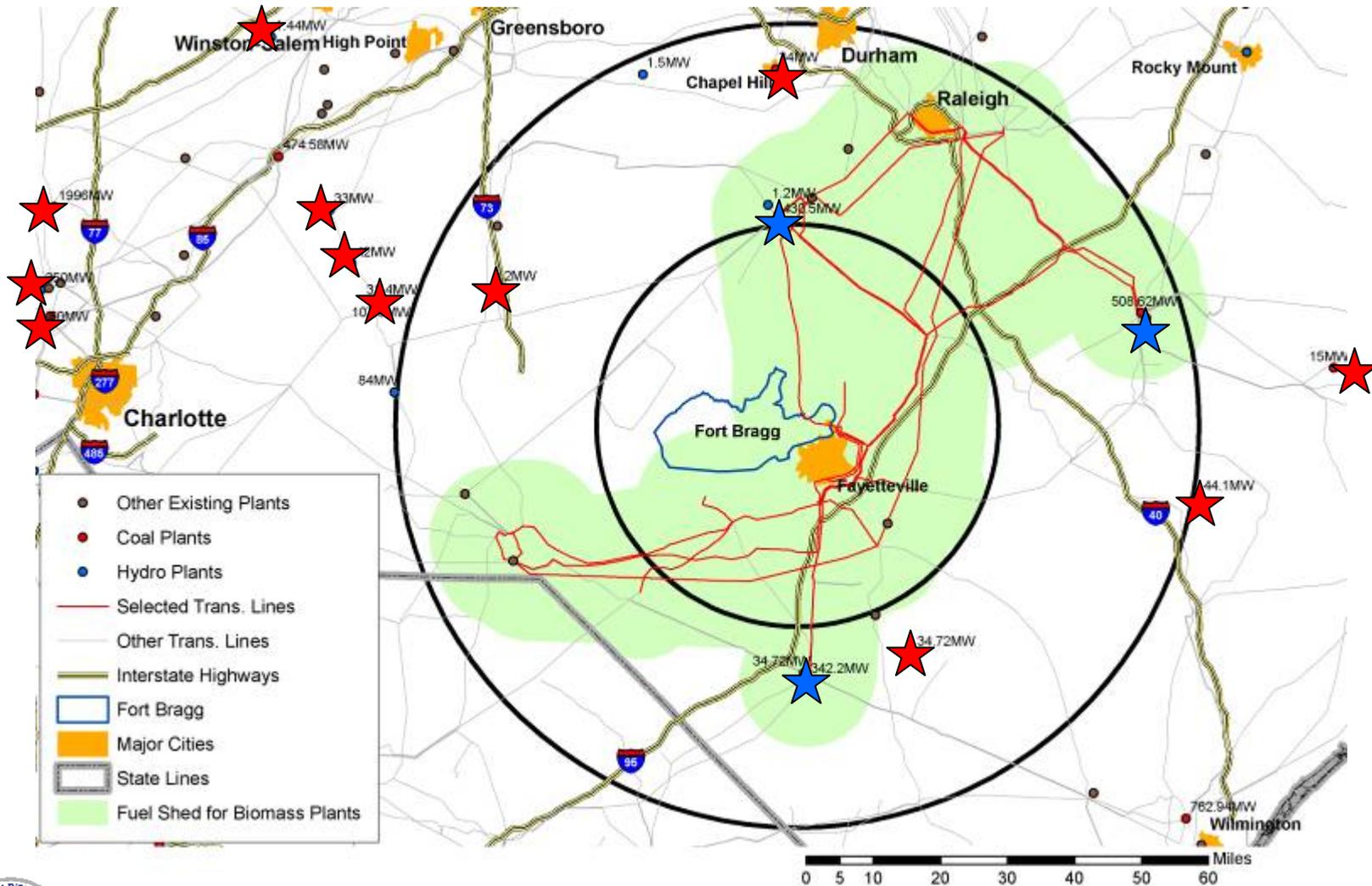
February 2008

*Office of the Under Secretary of Defense  
For Acquisition, Technology, and Logistics  
Washington, D.C. 20301-3140*



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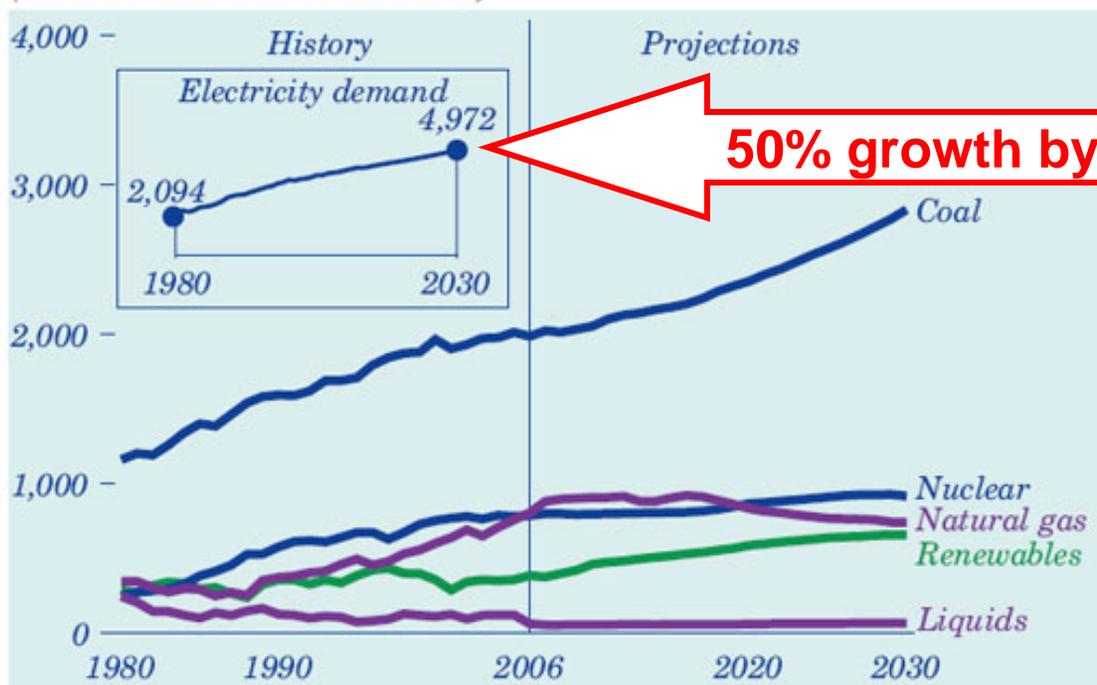
# “DOD Facility Islanding”



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# Projected US Electric Demand

Figure 7. Electricity generation by fuel, 1980-2030  
(billion kilowatthours)



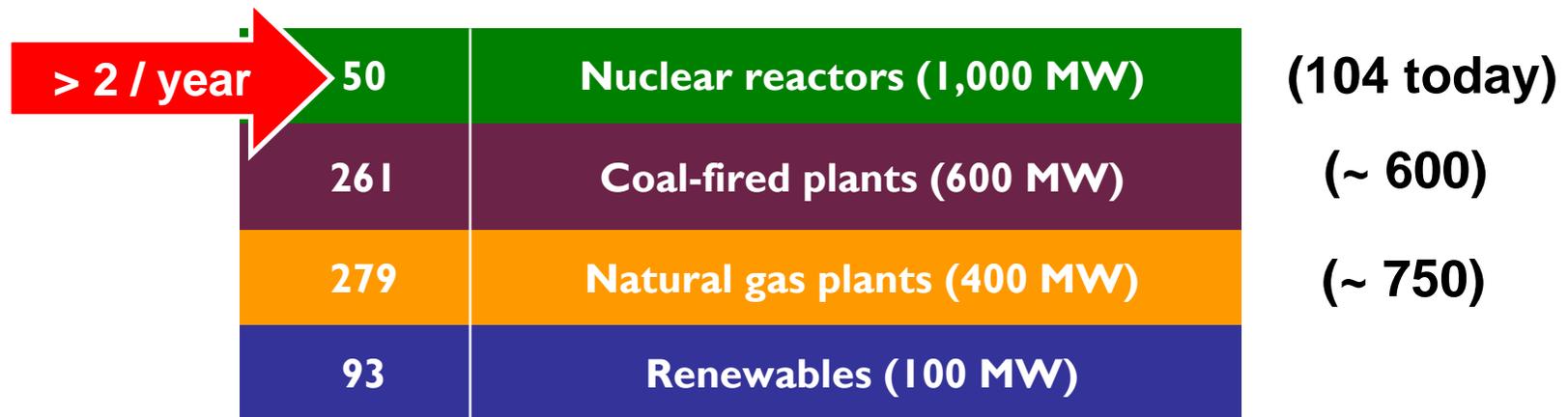
US EIA AEO 2009



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# 50% Electricity Demand Growth By 2030

To preserve current electric fuel supply mix:



Source: 2006 Annual Energy Outlook, Energy Information Administration

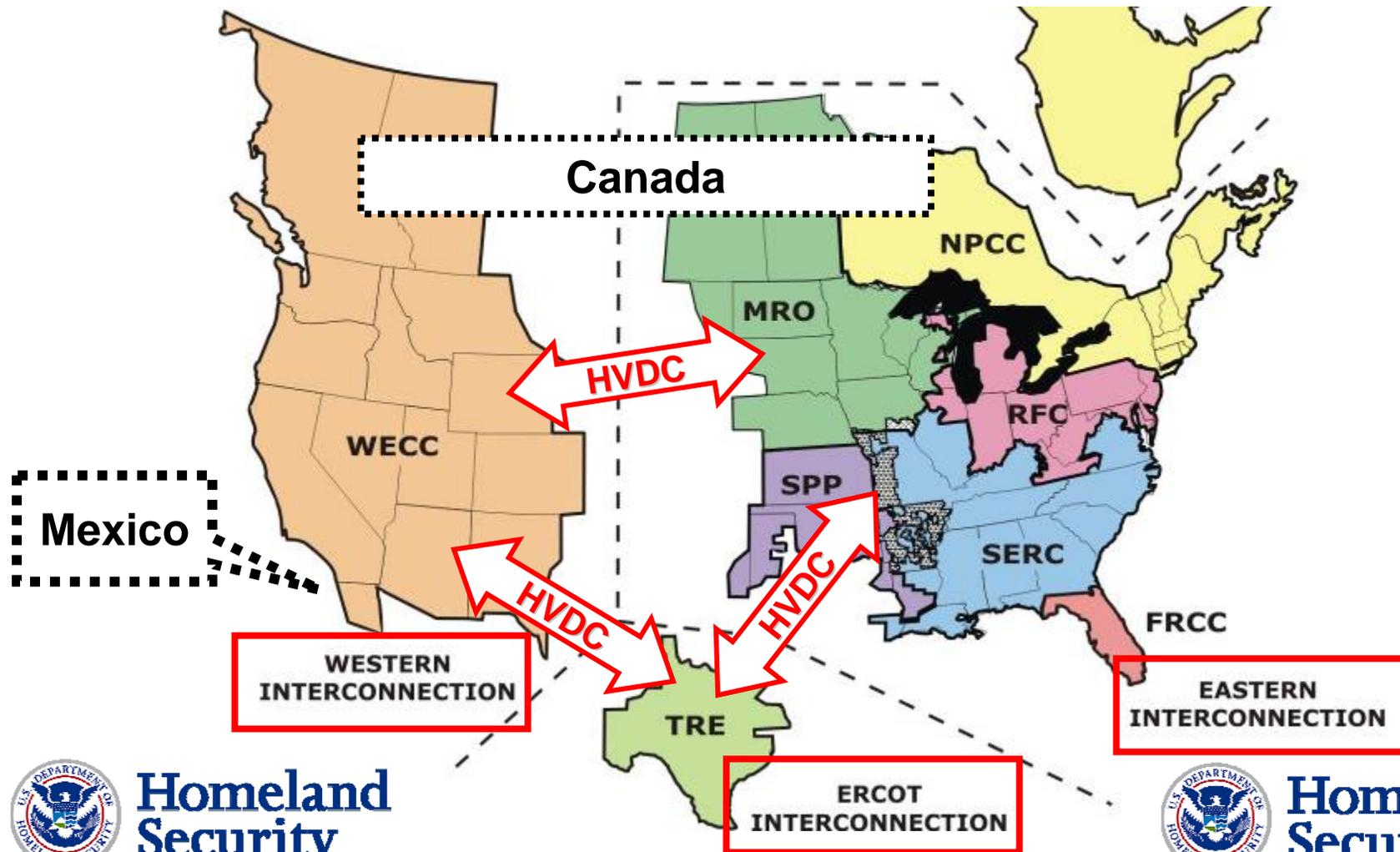
*Bigger grid needed to accommodate growth.  
Smart grid needed to integrate renewables and manage demand.*



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# North American Transmission Grid

Transmission owned by over 500 independent companies.  
Generation supplied by over 3000 utilities.



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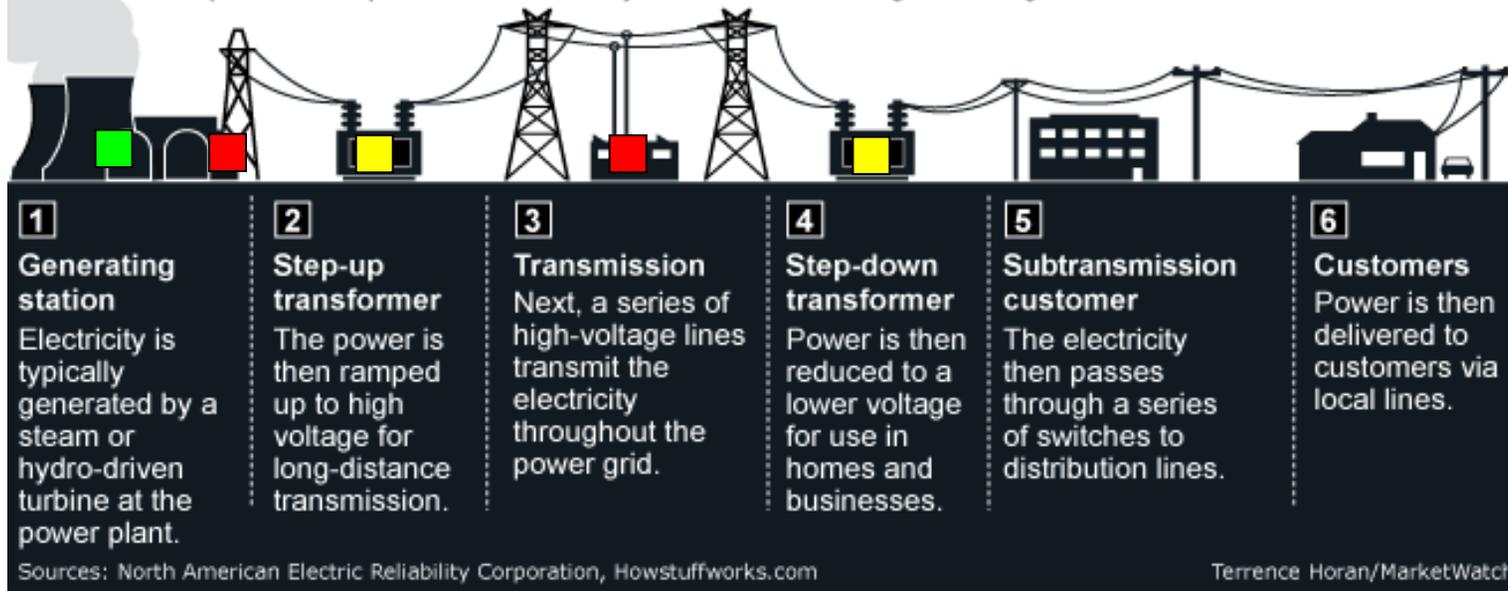


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# Grid Infrastructure

## The power grid

Below is a simplified example of how electricity is distributed throughout the grid.



 **Generators**

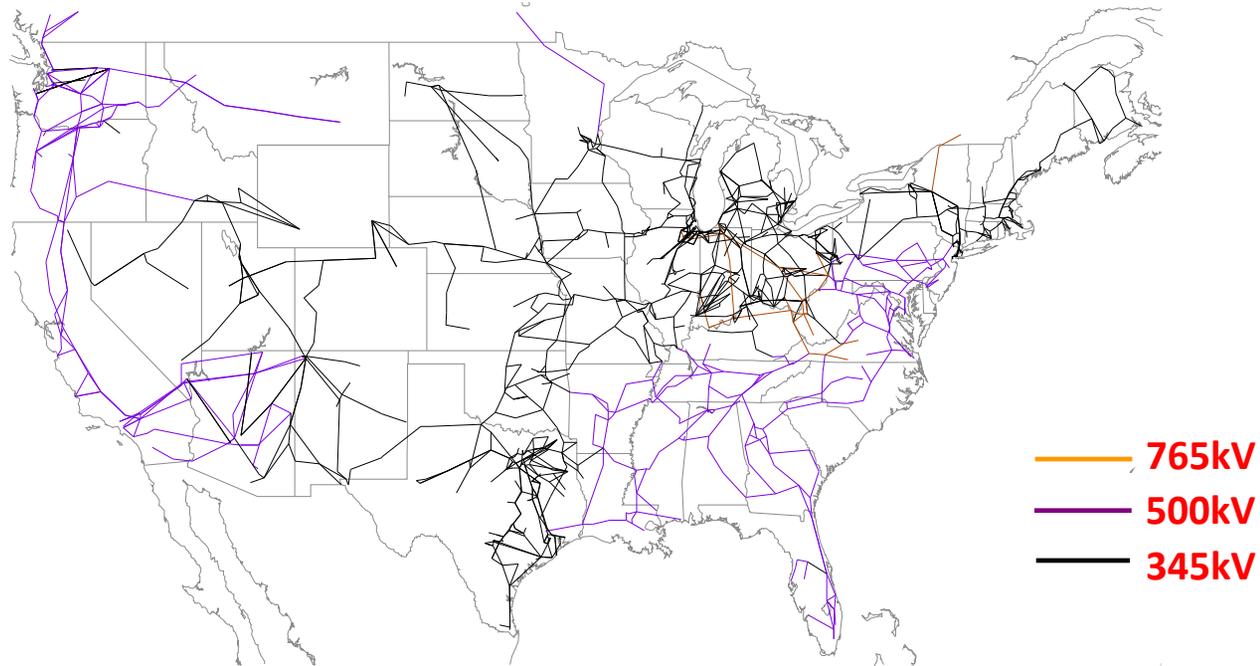
 **Circuit Breakers**

 **High Voltage Transformers**



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# EHV Transformers



- US spares.
- *500KV and 765KV manufacturing capability.*
- 100+ tons.
- Lead time 6 to 18 months.



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# EHV Transformer



Chain link fence

Person



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# Moving EHV Transformers



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# Emergency Transformers



**230 KV Mobile Transformer (Made in US)**



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# Major US Grid Substations

There are more than 25,000 power substations in the United States with a voltage rating of 34 kV (kilovolts) and above. Figure 4 shows the location of relevant (i.e., high-side voltage rating equal to or greater than 34 kV) substations in the United States and in portions of Canada and Mexico (Platts PowerMap 2004)

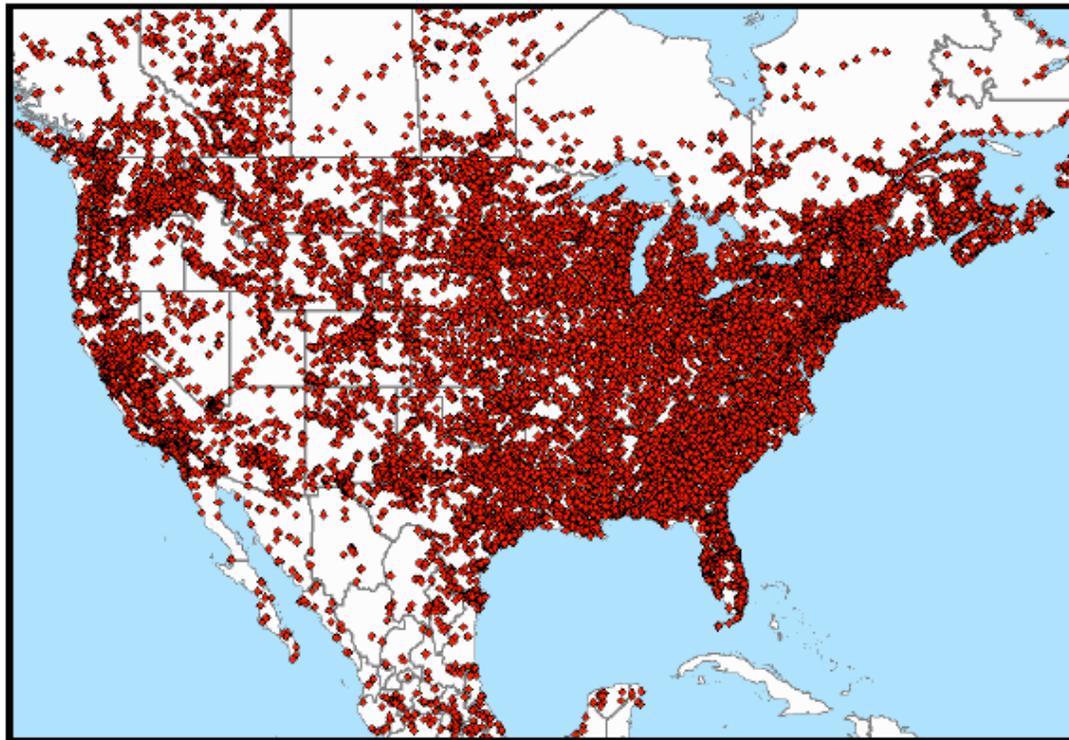


Figure 4 Locations and Density of “Major” Electric Substations in the United States (Source: Platts PowerMap 2004)



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- Eliza Newlin Carey
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## Insider Interviews

Q&A: JIM LANGEVIN

### Langevin Determined To Prevent A 'Cyber 9/11'

Rhode Island Democrat Supports White House Oversight Of Cybersecurity But Opposes Giving It To Any One Agency

Saturday, April 25, 2009

It's been a bleak April for the nation's cybersecurity. With hacks reported in the U.S. electrical grid and the Pentagon's Joint Strike Fighter program – not to mention the continuing specter of debilitating worms and viruses – officials are facing a battery of new questions about a persistent problem.

Rep. Jim Langevin, D-R.I., co-founded and co-chairs the House Cybersecurity Caucus, and he recently co-chaired a cybersecurity report from the Center for Strategic and International Studies for the 44th presidency. In a recent interview with *National Journal's* Winter Casey, Langevin discussed the importance of a national cyberspace office in the White House and a comprehensive security effort throughout not just the government, but the private sector as well.

Edited excerpts follow. Read the [Insider Interviews](#) archives for more discussions in the series.

#### NJ: What do you know about spies from Russia and China penetrating the U.S. electrical grid?

**Langevin:** I would rather not get into any classified intelligence information. But I will say that the threats to our electric grid and our vulnerabilities to potential cyber attack in general are very real, and they continue to grow, and they do concern me. I spent a great deal of time in the last year on this issue and will continue to pay a lot of attention to it.

#### NJ: Have spies penetrated other U.S. infrastructure?

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"The threats to our electric grid and our vulnerabilities to potential cyber attack in general are very real."  
-- Jim Langevin



# Homeland Security

THE WALL STREET JOURNAL Digital Network WSJ.com MarketWatch BARRONS All Things Digital SmartMoney

Wednesday, April 8, 2009

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TECHNOLOGY | APRIL 8, 2009

### Electricity Grid in U.S. Penetrated By Spies

Article | Video | Comments (146)

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By SIOBHAN GORMAN

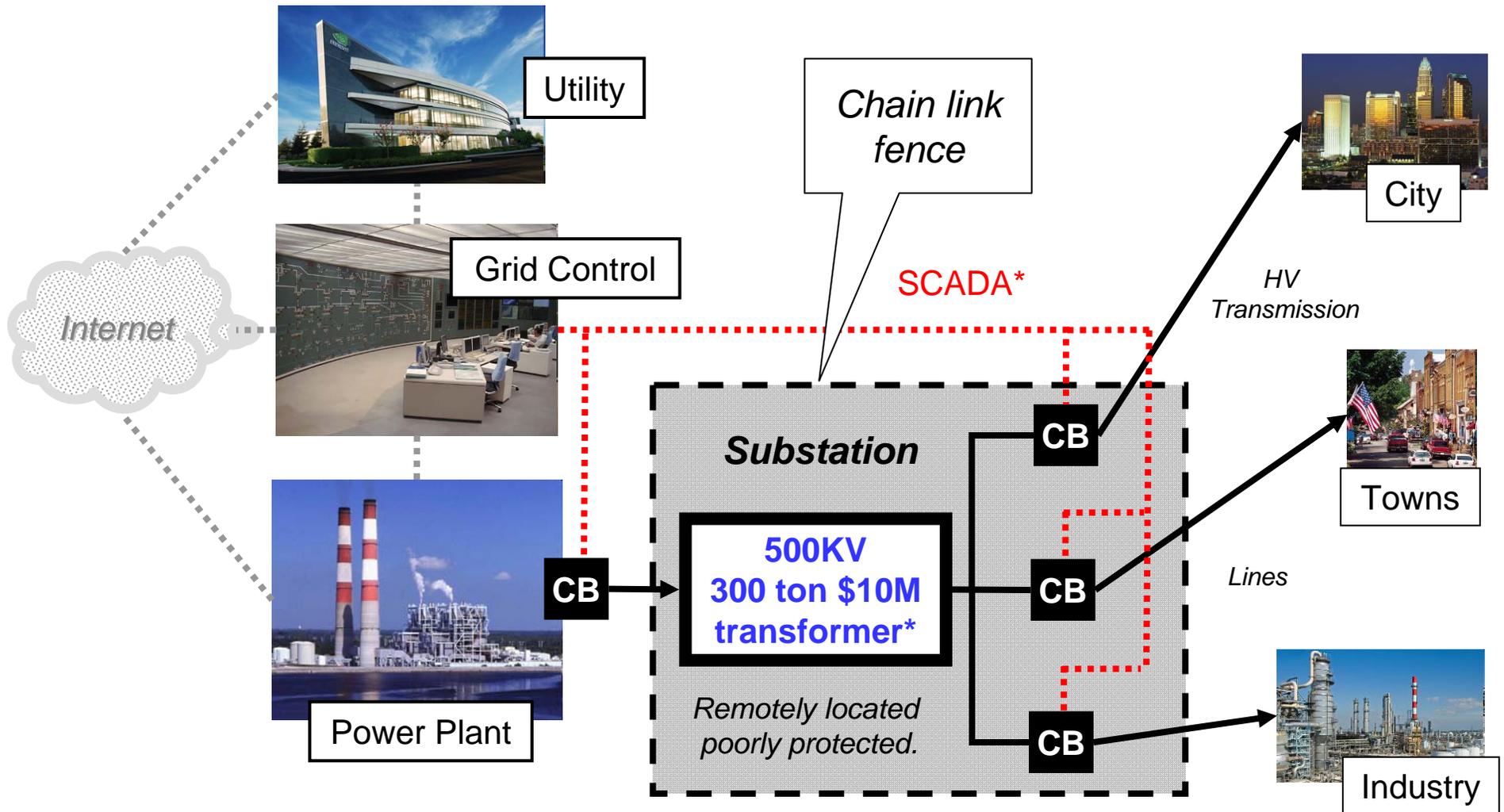
Associated Press

Robert Moran monitors an electric grid in Dallas. Such infrastructure grids across the country are vulnerable to cyberattacks.

WASHINGTON – Cyberspies have penetrated the U.S. electrical grid and left behind software programs that could be used to disrupt the system, according to current and former national security officials.

The spies came from China, Russia and other countries, these officials said, and were believed to be on a mission to navigate the U.S. electrical system and its controls. The intruders haven't sought to damage the power grid or other key infrastructure, but officials warned they could try during a crisis or war.

# System Control And Data Acquisition (SCADA) System



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CB = Circuit Breaker (remotely operable)

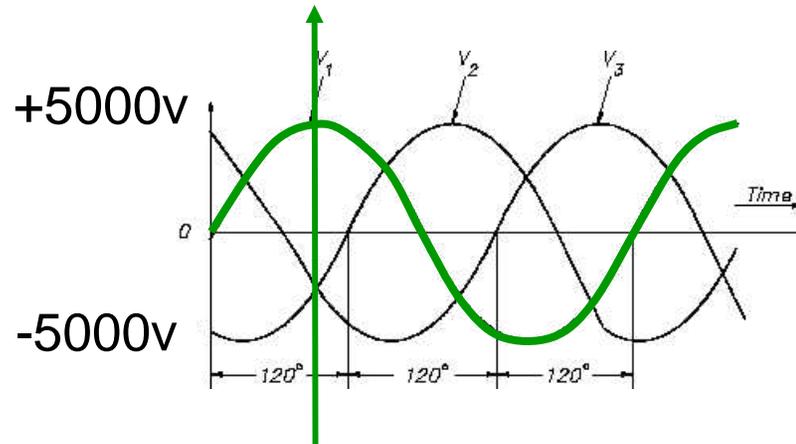
# EHV Circuit Breakers



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# 3 Phase Circuit Breaker Operation

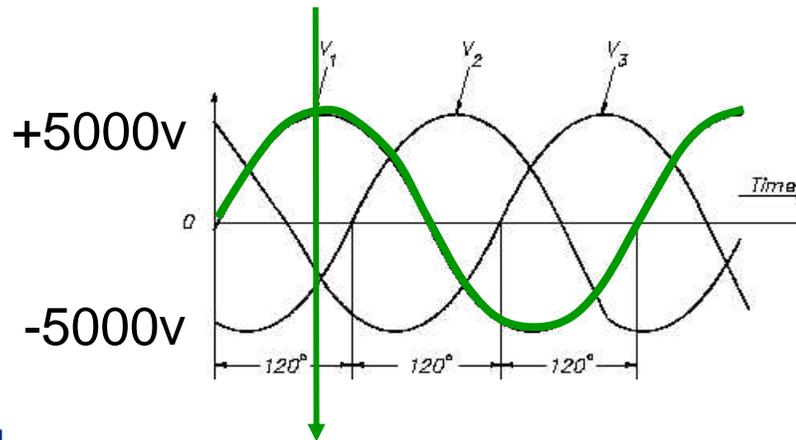
Power Plant



$$V_1 = +5000 \text{ vac}$$

In Phase

Grid



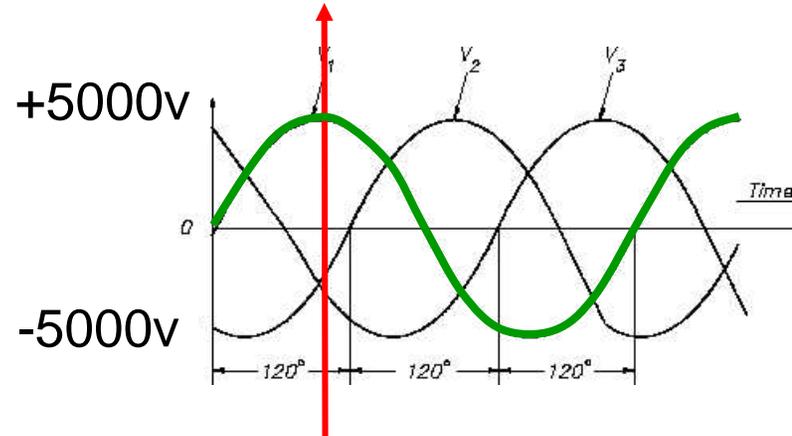
$$V_1 = +5000 \text{ vac}$$



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# 3 Phase Circuit Breaker Operation

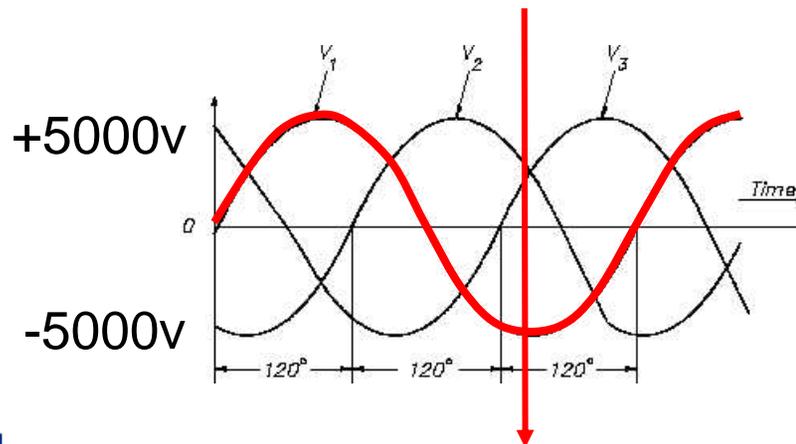
Power Plant



$v_1 = +5000 \text{ vac}$

Out of Phase

Grid



$v_1 = -5000 \text{ vac}$



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# 2007 Grid Cyber Test at INL

CNN.com / US

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International Edition

updated 11:06 p.m. EDT, Wed September 26, 2007

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## Sources: Staged cyber attack reveals vulnerability in power grid

### STORY HIGHLIGHTS

- Sources: Similar attack could hurt generators that produce nation's electricity
- Experts fear attacks could cause damage that would take months to fix
- Department of Homeland Security said staged attack took place in March
- DHS official: A lot of risk has been "taken off the table" since experiment

Next Article in U.S. »

READ

VIDEO

From CNN's Jeanne Meserve

TEXT SIZE

WASHINGTON (CNN) — Researchers who launched an experimental cyber attack caused a generator to self-destruct, alarming the federal government and electrical industry about what might happen if such an attack were carried out on a larger scale, CNN has learned.



Department of Homeland Security video shows a generator sparking smoke after a staged experiment.

Sources familiar with the experiment said the same attack scenario could be used against huge generators that produce the country's electric power.

Some experts fear bigger, coordinated attacks could cause widespread damage to electric infrastructure that could take months to fix.

CNN has honored a request from the [Department of Homeland Security](#) not to divulge certain details about the experiment, dubbed "Aurora," and conducted in March at the Department of Energy's Idaho lab.

In a previously classified video of the test CNN obtained, the generator shakes and smokes, and then stops.

DHS acknowledged the experiment involved controlled hacking into a replica of a power plant's control system. Sources familiar with the test said researchers changed the operating cycle of the generator, sending it out of control.

## "Aurora"

### Most Popular on CNN

#### STORIES

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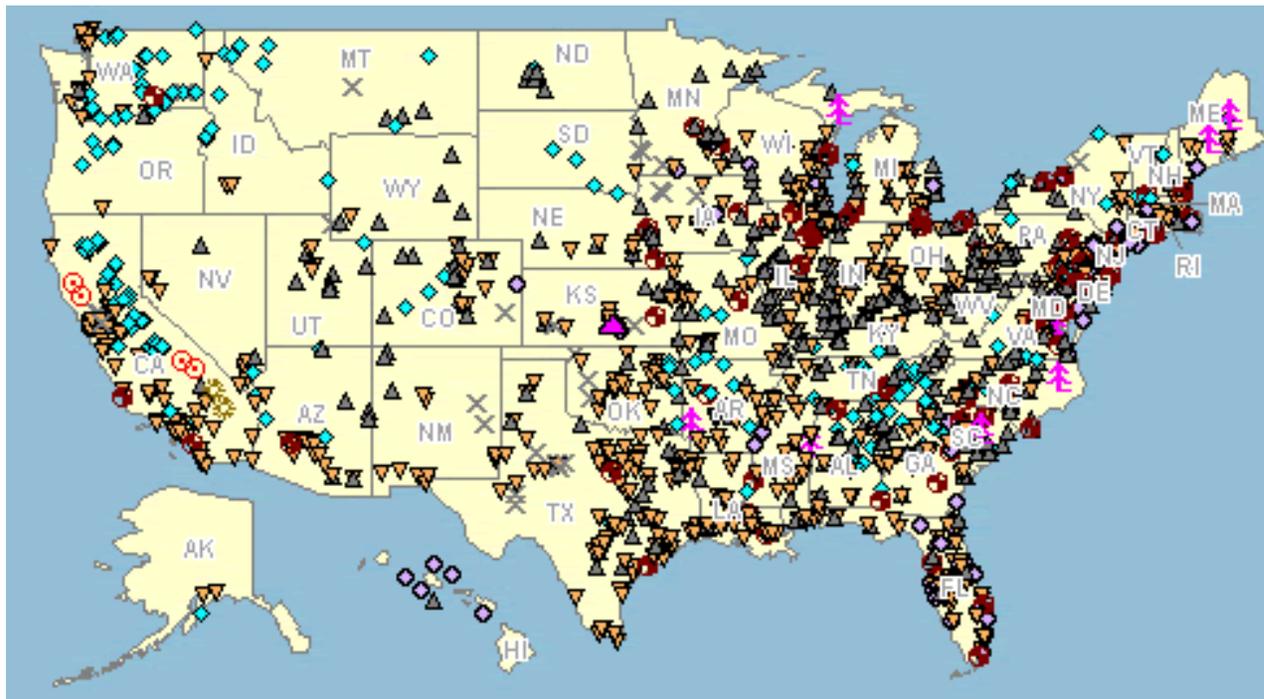
2 Search for Florida girl continues

<http://www.cnn.com/2007/US/09/26/power.at.risk/index.html>



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# Large US Power Plants



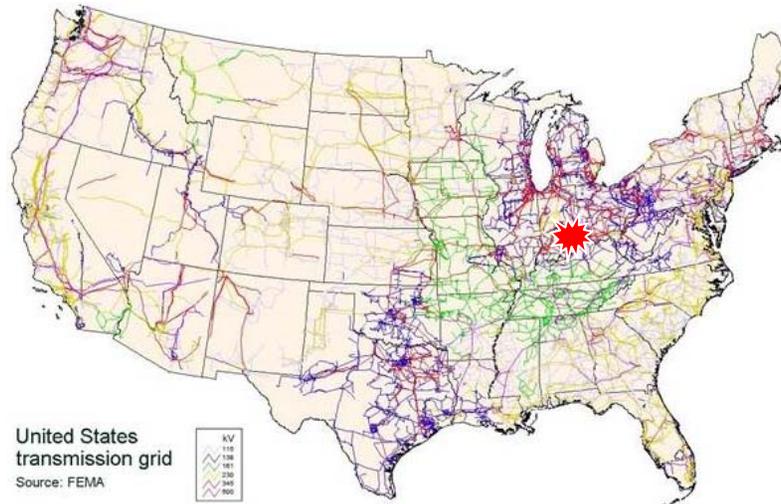
## Electric Power Plants

Min. net summer capacity of 100 megawatts  
(Values below are U.S. totals)

- ▽ Natural Gas (731)
- ▲ Coal (401)
- ◆ Hydro (183)
- ⊙ Petroleum (108)
- ⊕ Nuclear (66)
- × Wind (31)
- 🌲 Wood (8)
- ⊗ Geothermal (4)
- 🌱 Biomass (2)
- ☀ Solar (2)



# Wargame Scenario



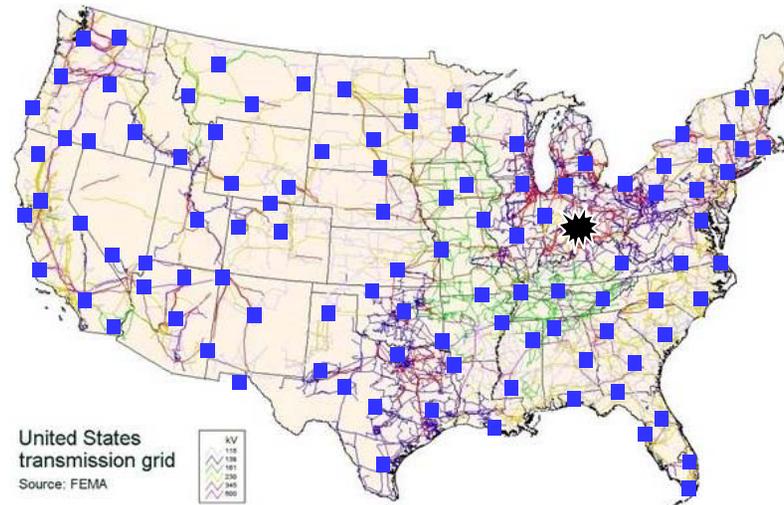
0500 – Columbus attacked.

0600 – Terrorist group claims responsibility and issues demands through media.



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# Wargame Scenario

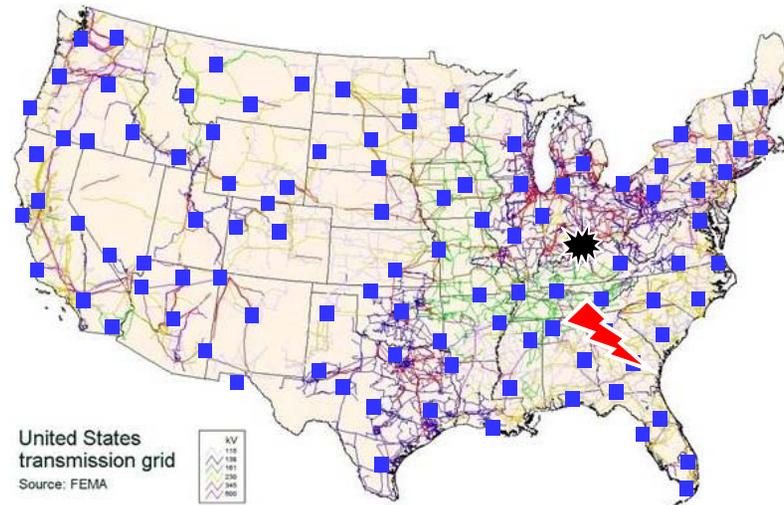


0900 – Government evaluates options for protecting EHV transformers.



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# Wargame Scenario

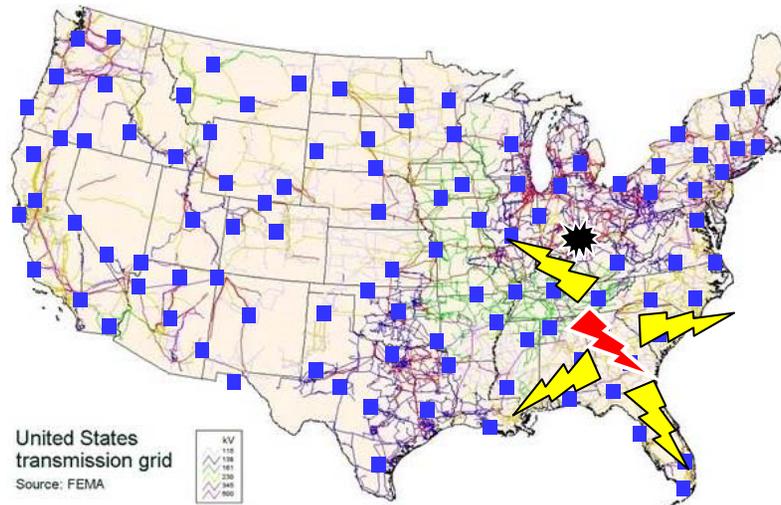


1215 – Cyber attack against a major utility SCADA system in US southeast.



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# Wargame Scenario

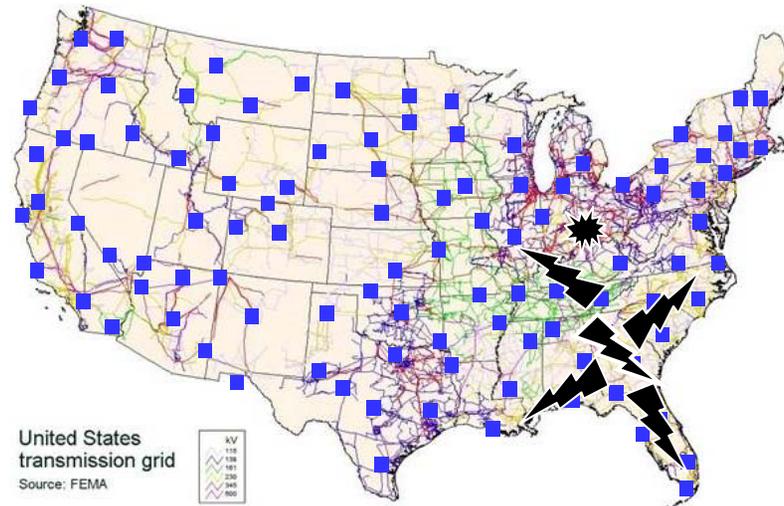


1220 – effects of major utility loss propagate through the US eastern interconnection.



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# Wargame Scenario



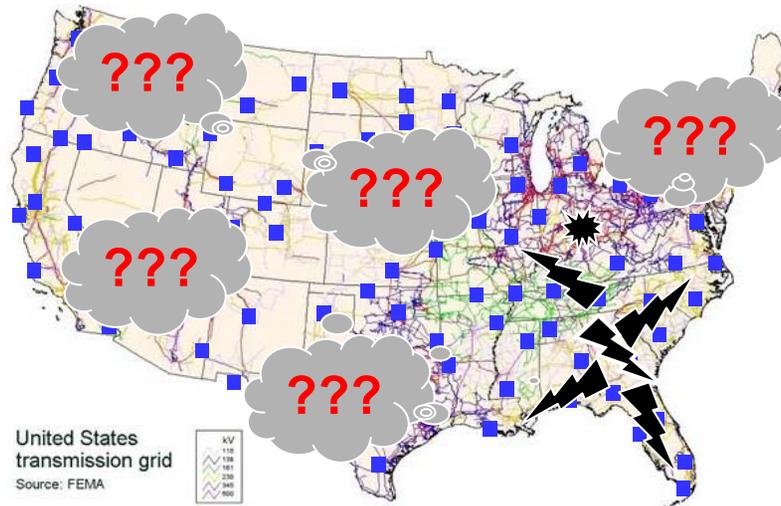
1230 – Columbus and most of Georgia, Florida, Alabama, South Carolina, North Carolina are blacked out.

1245 – terrorist group claims responsibility and issues new demands.



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# Wargame Scenario



- 1400 – Government considers options.
- 1500 – Intel intercepts provide new info.
- 1700 – Game over.



# DHS Recovery Transformer Program

Single 3 phase



Large & Heavy

3 single phase



Smaller & Lighter



Movable



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# Smart Grid



***Shift from coal to renewables is a big driver.***



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# FROM SCIENCE...SECURITY

Explosives



Chemical/Biological



Command, Control, & Interoperability



Borders/Maritime



Human Factors



Infrastructure/Geophysical



# FROM TECHNOLOGY...TRUST