# Cyber-Security Vs. Physical Security
# High Voltage vs. Low Voltage: Which Should Be A Priority?

Harvard Electricity Policy Group

June 13, 2014

Exelon

# Threats

## Lions and Tigers and Bears, Oh My!

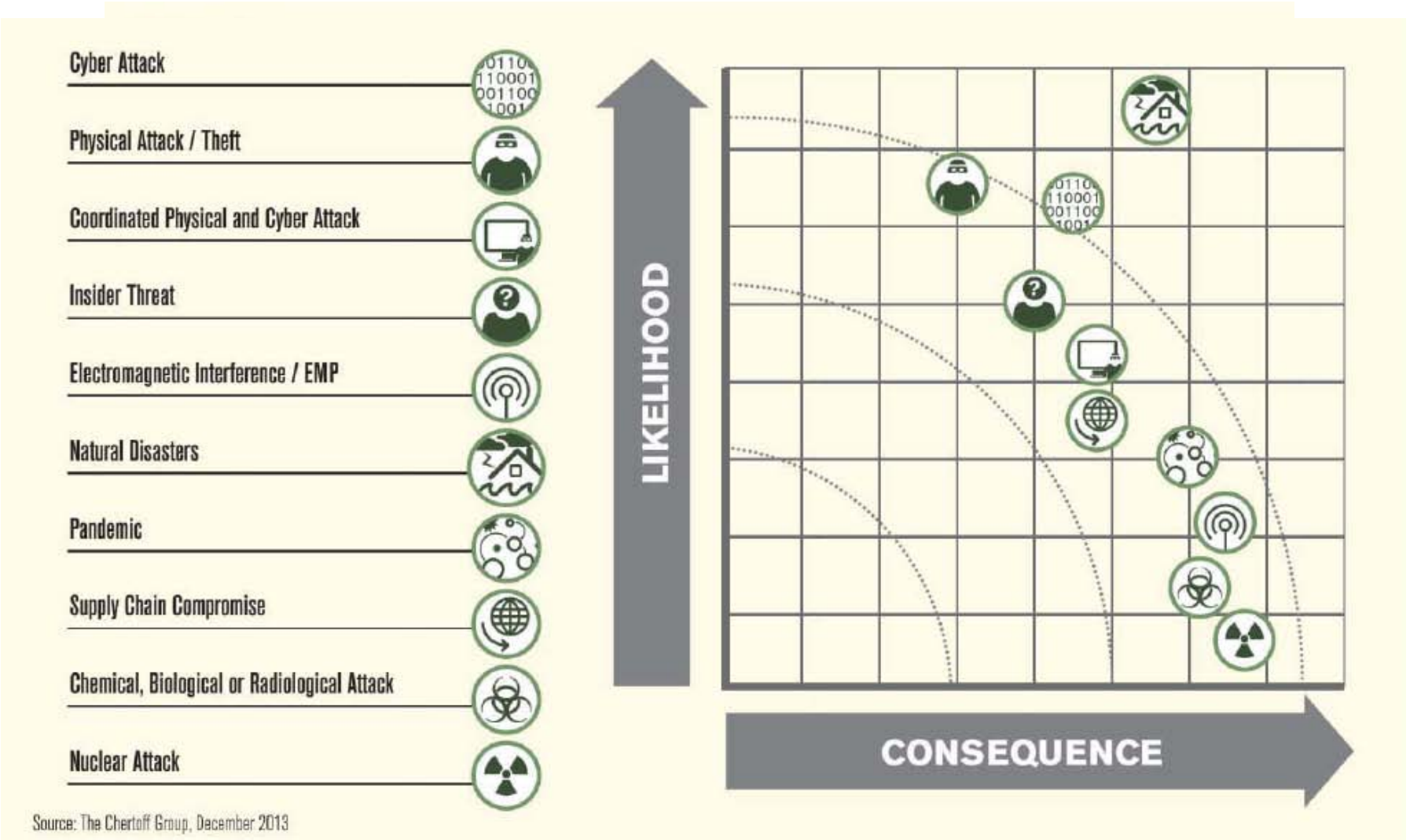
Source: The Wizard of Oz , Metro-Goldwyn-Mayer (1939)

# Threats

- Natural Events
  - Weather
    - Wind Storm
    - Snow/Ice Storm
    - Hurricane
    - Space Weather
- Human Intervention
  - Cyber Attack
  - Physical Attack
    - Kinetic Attack
    - Electromagnetic Interference Attack (EMI)
    - High Altitude Electromagnetic Pulse Attack (HEMP)

# Threats

## Threat Landscape: ELECTRIC POWER SECTOR




Source: EEI Perspectives, May/June 2014 page 32



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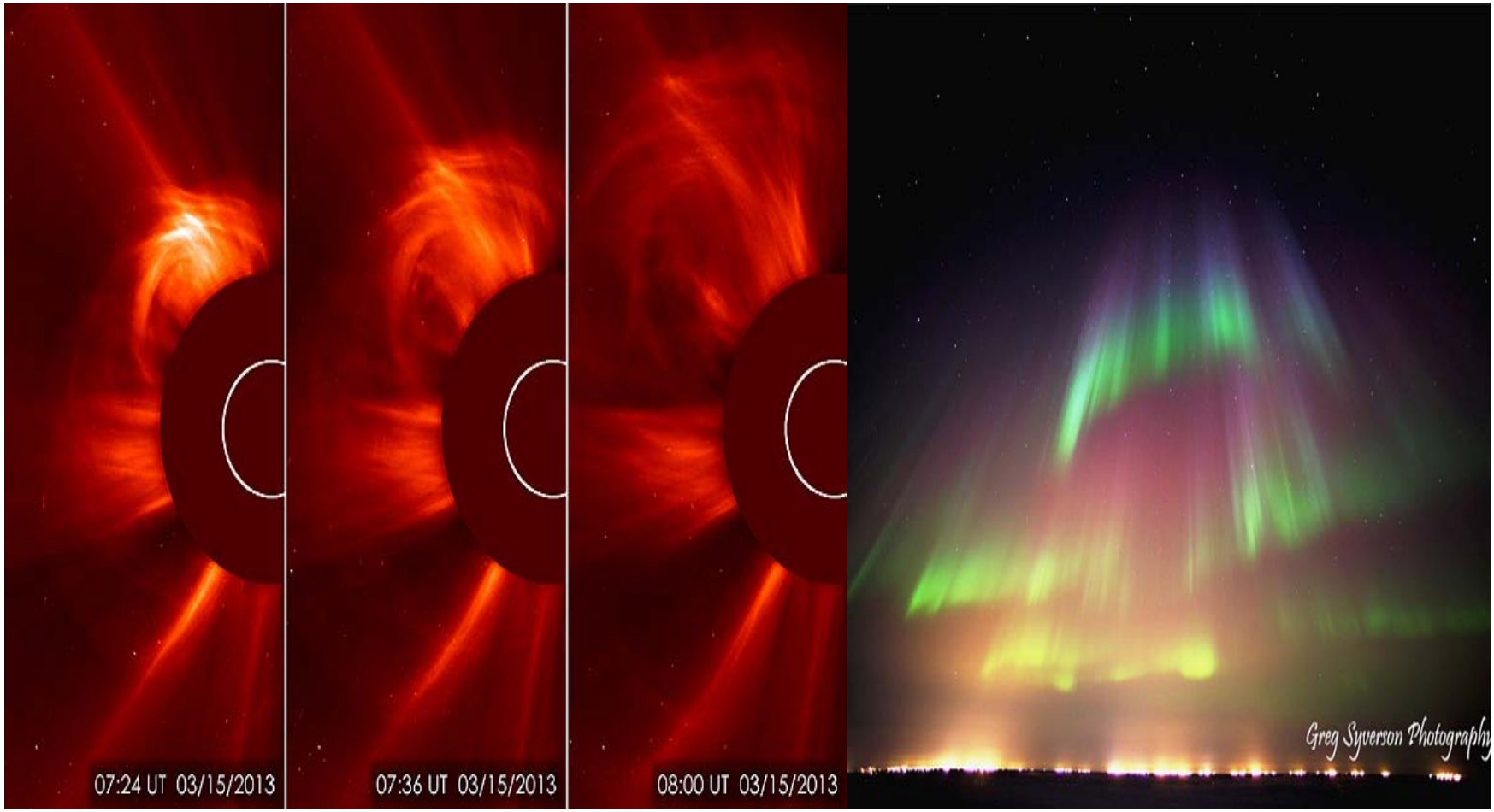
# Space Weather

## Coronal Mass Ejection/Aurora Two Days Later




Source: ESA and NASA Solar Heliospheric Observatory (SOHO); Aurora over Prudhoe Bay, Alaska. 3/17/2013 Image Courtesy of Greg Syverson



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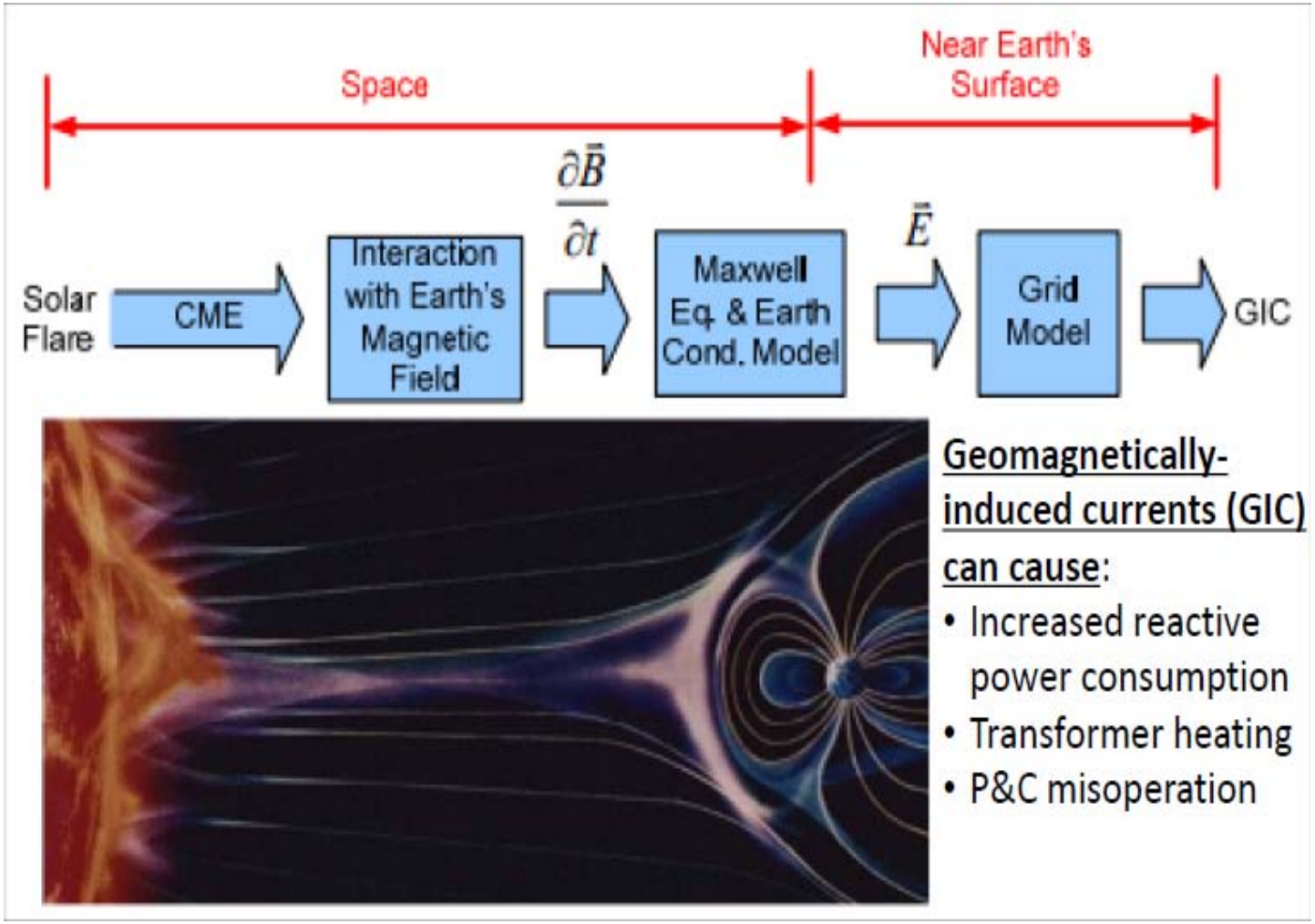
# Space Weather

## Impact on Power System




Source: Draft TPL-007-1 Standards Drafting Team Industry Webinar, page 6 (Apr. 24, 2014)



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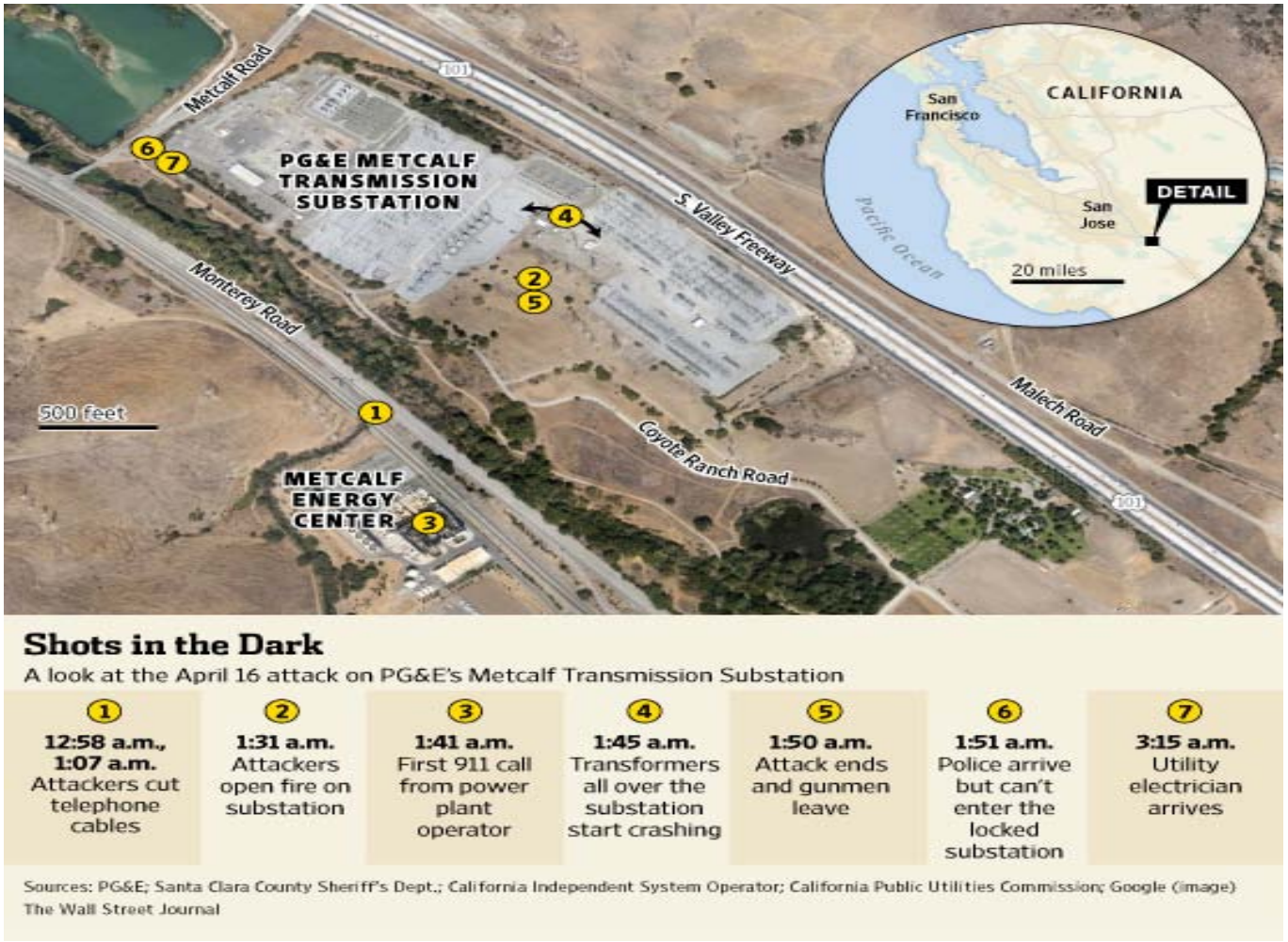
# Physical Security

## Kinetic Attack




Source: Wall Street Journal, Assault on California Power Station Raises Alarm on Potential for Terrorism, Feb. 5, 2014



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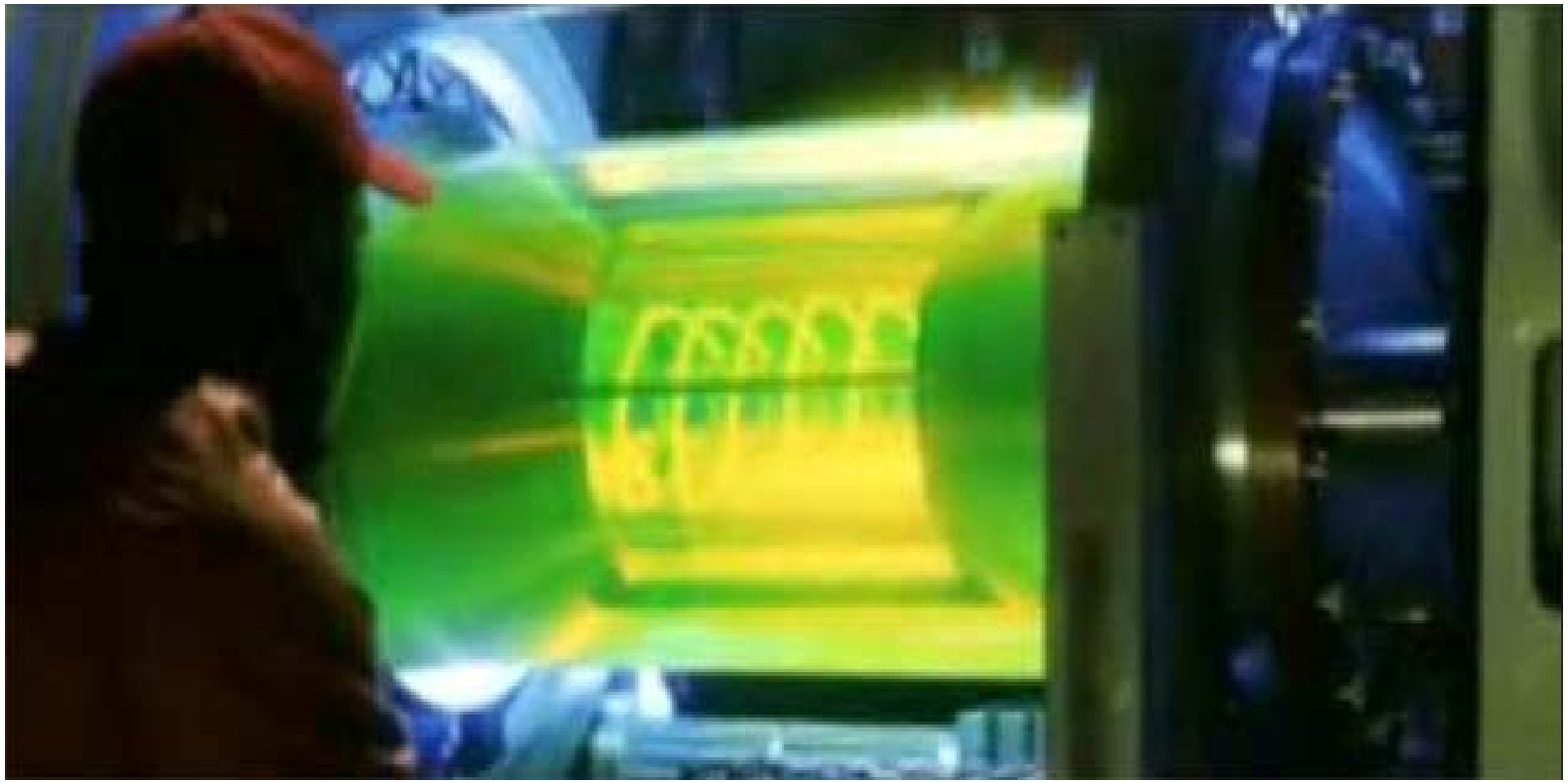
# Electromagnetic Interference Attack

## Fictional Truck Device



Source: Ocean's 11

# Electromagnetic Interference Attack

## Compact Device?


Source: Photograph Courtesy of Steven T. Naumann



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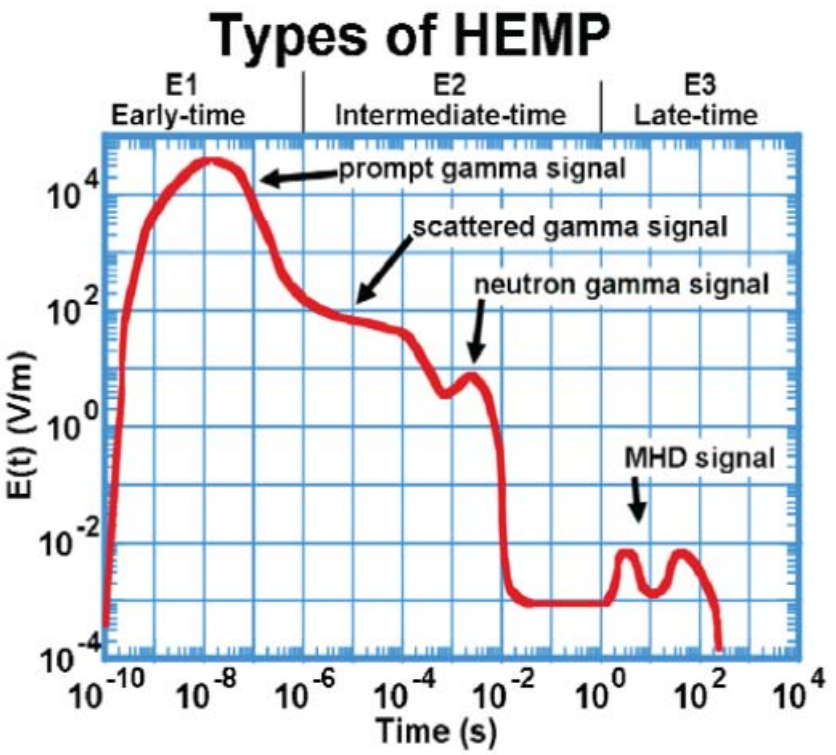
# HEMP Attack

- Detonation of a nuclear device at altitude
  - Starfish Detonation 1962 as seen in Hawaii




Source: NERC, High Impact, Low-Frequency Event Risk to the North American Bulk Power System, Figs. 13-14 (June 2010)



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# HEMP Attack

- Detonation of a nuclear device at altitude
  - Gamma-yield enhanced weapons
  - Line of Sight Effect
- E1 Impact
  - Line of sight effect
  - Substation and Generation Controls and Communications
  - Control Centers and SCADA
  - Possible Insulator Flashover on Distribution Lines
  - Smart Grid Semiconductor Devices
- E3 Impact
  - Similar to impact of space weather

# Impacts

- Natural Events
  - Weather
    - Wind Storm - Distribution
    - Snow/Ice Storm – Distribution/Some Transmission
    - Hurricane – Distribution/Some Transmission
    - Space Weather – High Voltage Transmission
- Human Intervention
  - Cyber Attack – Transmission/Distribution/Generation
  - Physical Attack
    - Kinetic Attack – Transmission/Distribution/Generation
    - EMI Attack – Transmission/Control Centers/Generation (not widespread)
    - HEMP Attack– Entire System

# Prevention - Mandatory Reliability Standards

- Natural Events
  - Weather
    - Space Weather
      - Reliability Standards for Geomagnetic Disturbances, Order No. 779, 143 FERC ¶ 61,147 (2013)
      - EOP-010 filed Nov. 13, 2013; RM14-1 (awaiting FERC action)
      - TPL-007 (under development)
- Human Intervention
  - Cyber Attack
    - CIP-002 through CIP-011 (CIP V5)
    - Version 5 Critical Infrastructure Protection Reliability Standards, Order No. 791, 145 FERC ¶ 61,160 (2013)
  - Physical Attack
    - Kinetic Attack
      - FERC Order in Docket No. RD14-6, 146 FERC ¶ 61,166 (March 7, 2014)
      - CIP-014: Docket No. RM14-15 (filed May 23, 2014)

# Prevention – Other Processes

- Response to Threats
- Information Sharing – Electric Sector – Information Sharing and Analysis Center (ES-ISAC)
- DHS Industrial Control Systems Cyber Emergency Response Team (ICS-CERT)
- Transfer of tools and technologies from the government
- Physical Security at stations not required by CIP-014

# Resiliency and Restoration

- Spare Transformer Equipment Program (STEP)
  - Sharing assets following an event – a terrorist attack resulting in the destruction or long-term disabling of transmission transformers
  - Transmission-to-Transmission Transformers
  - 50 Utilities participating
  - Binding contractual arrangement
- Spare Connect
  - Voluntary programs – open to all utilities
  - Transmission-to-Transmission Transformers, Generator Step-Up Transformers, Auxiliary Substation Components (bushings, fans, radiators)
- Transformer Transportation
- Recovery Transformer (RecX)
  - EPRI/DHS
  - Modular, small and lighter allowing for easier transportation and more rapid installation
  - 20 hours St. Louis – Houston/Energized in Five Days
- Incident Response – Planning and exercising coordination

# Resiliency and Restoration

## 200 MVA 345/138kV Single Phase Recovery Transformer


Source: Photo Courtesy of DHS S&T



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# Priorities

- Distribution Level Outages More Frequent and Cause Outages
- Transmission Level Outages Less Frequent and Rarely Cause Customer Outage
- But:
- Some Transmission Events (Coordinated Physical Attacks, Coordinated Cyber Attacks, Severe GMD Storm, HEMP Attack) are **H**igh **I**mpact, **L**ow **F**requency (HILF) Events – these affect everyone
- Cannot Prevent Everything
- Three-Legged Policy
  - Prevention
  - Resiliency
  - Restoration

# What Should Be Done?

- Electricity is Critical to Modern Society
- New Threats to Continuity of Service/Time for Restoration
- Intersection Between Utility Operations and National Security
- Public-Private Partnership
- Electric Sub-Sector Coordinating Council (ESCC)
  - Serves as the principal liaison between the federal government and the electric power sector, with the mission of coordinating efforts to prepare for, and respond to, national-level disasters or threats to critical infrastructure
  - Includes utility CEOs and trade association leaders representing all segments of the industry
  - Government counterparts include senior Administration officials from the White House, relevant Cabinet agencies, federal law enforcement, and national security organizations
- Need a balance – everything cannot be a priority
  - Role for the government also

# Cost Recovery

- This all costs money
  - Distribution risks
    - More frequent, directly affect customers
    - Physical attacks
      - Cannot protect each distribution station and limited scope of damage to system as a whole
      - Are there specific very critical distribution substations to national and economic security?
  - Transmission risks
    - New risks – high impact, low frequency
    - What threat to plan for?
  - Balance between prevention, resiliency and restoration
  - For high-impact, low frequency events, need policy developed by industry and government