



EMP CASE STUDY:

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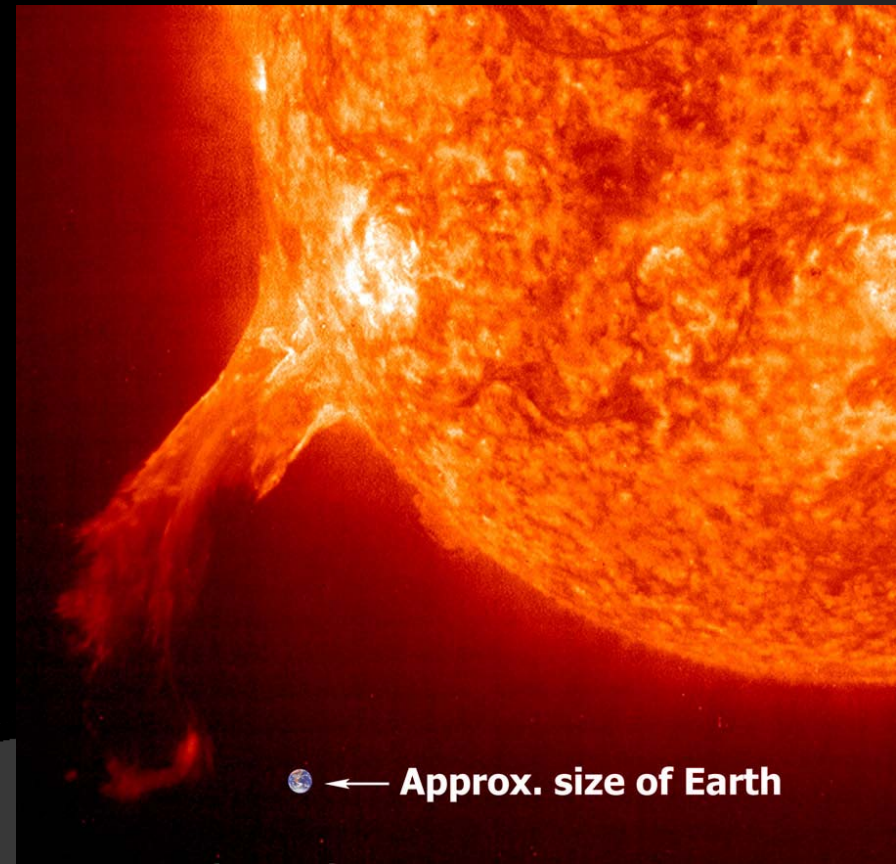
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What is EMP?

- Electromagnetic Pulse (EMP) is a burst of electromagnetic energy that creates fluctuating electric and magnetic fields
- EMP is absorbed on contact by metallic surfaces

Two Types of EMP Events:

- Natural (Solar Flares)
- Nuclear Attack



← Approx. size of Earth

What is EMP?

Nuclear EMP has 3 composite waveforms:

- E1: fastest pulse (nanoseconds) and shortest waveform
 - Produces intense electric field that quickly induces high voltages in conductors
 - Too fast a pulse for surge protectors to defend against
- E2: fast pulse (hundredths to tenths of seconds)
 - Produces electromagnetic pulses and waveforms very similar to lightning
- E3: very slow pulse (tens to hundreds of seconds)
 - Produces large Geomagnetically Induced Currents (GIC) that can damage large electrical components

EMP Effects are Dependent on the Size of the Conductors Present

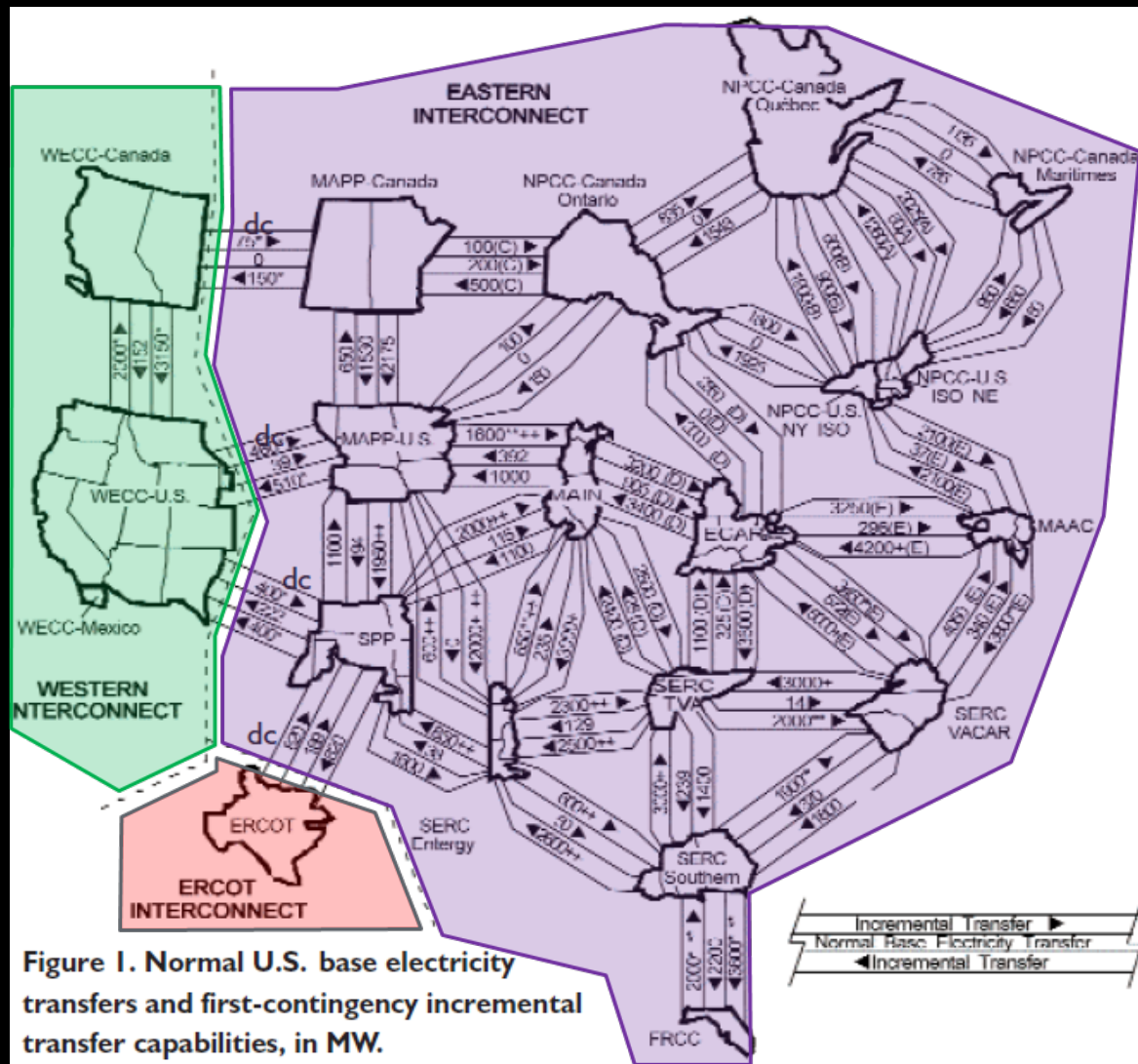
- Large Contact Surfaces: Permanent Damage
 - AC Power Lines
 - Telecommunication Lines
 - Electric Grid Transformers
 - Space Stations and Satellites
- Small Contact Surfaces: Possible Minor Damage
 - Laptops
 - Cell Phones
 - Household Appliances

Types of Attacks

Scale	Vignette	Adversary	Location	Type of Device	HOB	Yield	Delivery
National	4	Peer/near-peer Competitor	Heartland	Thermonuclear	300 km	300kT	Satellite
Local	8	Criminal element	Wall Street	Non-nuclear EMP	Ground-level	-	Van
Regional	7	Rogue nation supporting a terrorist organization	NE Corridor	Fission	40 km	40kT	-

Natural attacks are also possible, and would generate effects similar to a National Nuclear attack

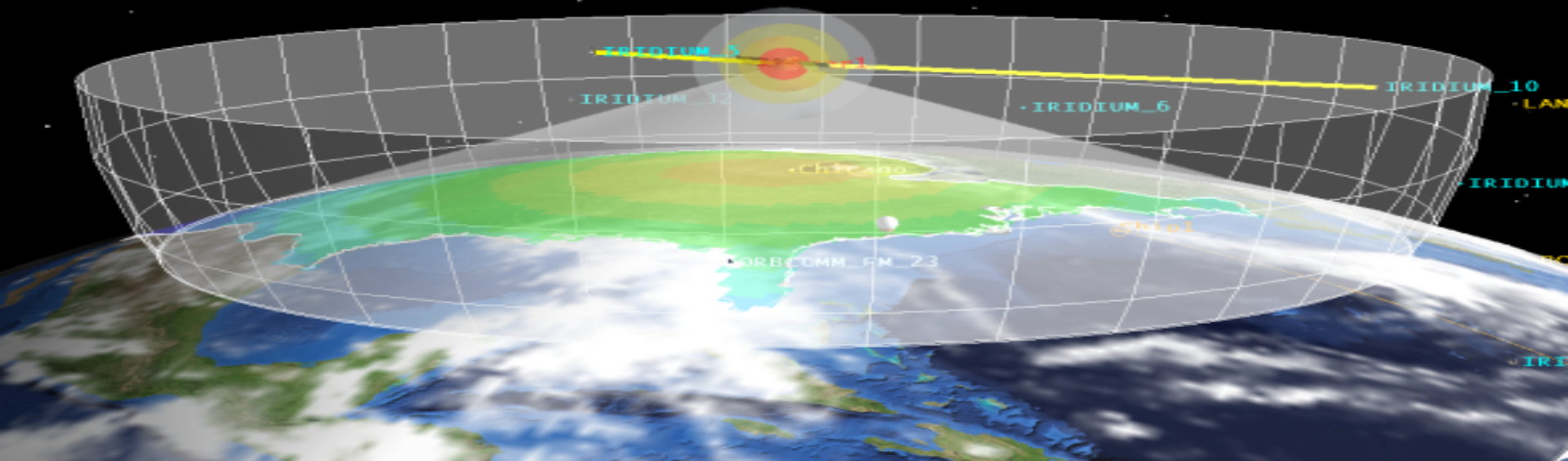
Interconnectivity of U.S. Power Grid



Power Infrastructure could potentially collapse following sufficiently robust EMP attack

Opportunities in EMP Impact Analysis

- FMEA/FMECA : EMP Commission Report Methodology
 - Bottom Up Approach
 - Fails to Account for Combined Effects Across Infrastructures
- Fault Tree Analysis:
 - Top Down Approach
 - Does Not Find All Initiating Faults



How much Protection Can I Get for a Dollar?

Project Goal Options:

- Develop Methodology:
 - Hybrid Approach to support FMEA/FTA analysis
 - Horizontal Approach to Find all Fault Points and Measure “Domino Effect”
- Simulation Model:
 - Visual Application of Bouncing-Failure Analysis

Objectives:

- To Analytically Rank Infrastructure Interconnectivity by Percent Effectiveness and Cost
- Compare Target Systems Analysis to Bouncing-Failure and Other Current Methodologies

Questions?

