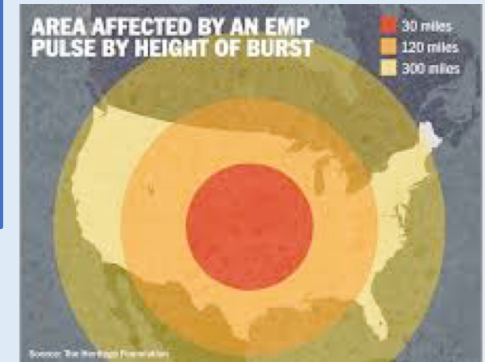


Understanding the Potential Impact of EMPs and Solar Events



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Presentation Overview

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- What is an EMP
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About Me

- Amateur Extra
- ARRL Emcom Level 2
- FBI / Infragard Program
- National EMP SIG Member
- Tinley Park EMA, Skywarn, ARES, and RACES
- FEMA, DHS, and Army Corp of Engineers Certifications
- Red Cross & AHA

What is an EMP

An **Electromagnetic pulse (EMP)** (aka *transient electromagnetic disturbance*) is a short burst of electromagnetic energy. Such a pulse's origination may be a natural occurrence or man-made & can occur as:

- **Electromagnetic Radiation**
- an **Electric** field
- a **Magnetic** field
- a **Conducted Electric Current**

EMP interference is generally **disruptive** or **damaging** to electronic equipment.

At higher energy levels a powerful EMP event such as a lightning strike **can damage** **physical objects** such as buildings and aircraft structures.

The management of EMP effects is an important branch of **electromagnetic compatibility (EMC) engineering**.

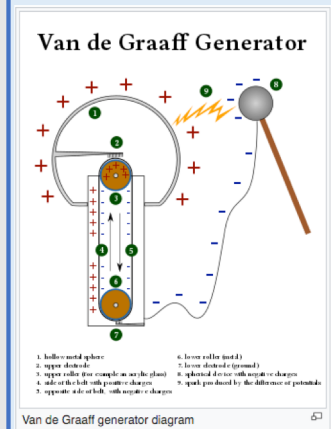
Classes of EMPs

- E1** Generally between 50KW to 200KW
Intense long pulses that can last from seconds to minutes.
- E2** $\geq 20\text{KW}$ to $\leq 35\text{KW}$
Shorter pulses that can last for many minutes.
Like widespread dry lightning.
- E3** $\leq 5\text{KW}$
Induced by 300M long objects.
Only mode comparable to a Solar CME.

Types of Natural EMPs



- **Lightning Electromagnetic Pulse (LEMP)**. The discharge is *initially a huge current* flow (\geq *mega-amps*), followed by a *train of pulses of decreasing energy*.
- **Electrostatic discharge (ESD)** Resulting from *two charged objects* coming into *close proximity or contacting*.
- **Meteoric EMP** The discharge of electromagnetic energy resulting from either the *impact* of a meteoroid with a spacecraft or the *explosive breakup* of a meteoroid passing through the Earth's atmosphere.
- **Coronal Mass Ejection (CME)**. A *burst of plasma* and accompanying *magnetic field*, ejected from the solar corona and released into the solar wind. Sometimes referred to as a **Solar EMP**.



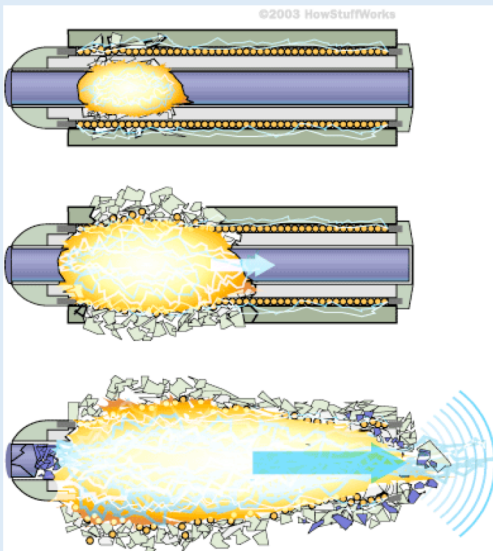
Types of Civil (Man-Made) EMPs

Switching action of electrical circuitry, whether isolated or repetitive (*as a pulse train*).

- **Electric motors** can create a *train of pulses* as the internal electrical contacts make and break connections as the armature rotates.
- **Gasoline engine ignition systems** can create a *train of pulses* as the spark plugs are energized or fired.
- **Continual switching actions of digital electronic circuitry.**
- **Power line surges.** These can be *up to several kilovolts*, enough to *damage electronic equipment* that is insufficiently protected.



Types of Military EMPs



- **Nuclear Electro-Magnetic Pulse (NEMP)**, as a result of a *nuclear explosion*.

- **High Altitude Nuclear EMP (HEMP)**, which produces a *secondary pulse* due to *particle interactions with the Earth's atmosphere and magnetic field*.

- **Non-Nuclear Electro-Magnetic Pulse (NNEMP) weapons**.



History of EMP Events

- **Carrington CME - August 1859** wide spread electrical damage to *telegraph wires*.
- **Starfish Nuclear test 1962** caused localized damage to electronics on *Hawaii*.
- Test by **Soviet scientists in Kazakhstan** triggered *power plant fires in Karaganda*.
- **Canadian CME - March 1989** knocked out power for *3 weeks for 60% of Canadians*.
- **United States** set up a commission to assess the *threat from an EMP attack in 2001*.
- The "Halloween storms" of 2003, for instance, interfered with satellite communications, produced a brief power outage in Sweden, and lighted up the skies with ghostly auroras as far south as Florida and Texas.
- **2010 Dr Liam Fox**, *warned North Korea & Iran seek to detonate HEMP over Britain*.
- **In fiction, the 1995 James Bond film GoldenEye**

Real-World Expectations

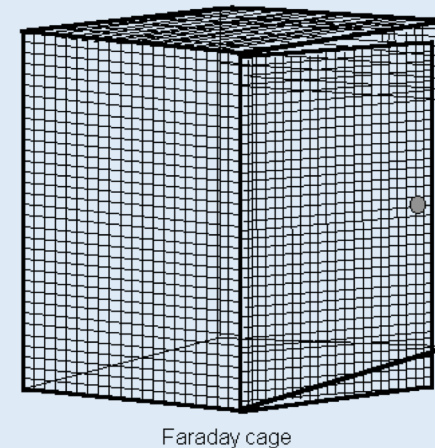
- Our **power grid is seriously under protected and at risk.**
 - It takes a year to produce to large transformers we use in the electrical grid core.
 - We have six spares for the entire U.S.
 - We have 26 such transformers in the Midwest alone.
- **Automobiles probably will fail**, but will work once the event is over, and they are restarted.
- **Planes are not likely to fall from the sky** as popular literature suggests.
- **Radios and most other electronics that are operating during the event will likely be damaged.**
- **Electronics that are powered off might survive.**
- **Electronics protected by a Faraday cage** that reduce the **EMP by 50db** greatly increases the likelihood of devices survival.
- New fangled batteries have electronics (18650, CR123, ...)

Preparedness Strategies

- Add tube based radios to your shack. (No semiconductors, micro, or nano-scale parts.)
- **Make a Faraday Cage and place backups for important electronics.**
- Add a flash drive with manuals, personal identification, and household records
- Add spare parts you might need to repair failed radios and electronics..
- Add spare radios, a digital camera, a tablet, flashlight, and batteries.
- Add spare parts, battery, service manuals, and skills to repair your generator.
- Save that old mechanical wristwatch.
- Add a backup Alternator and Voltage regulator
- Save you pre-1970 vehicle.
- Buy a Baja Warrior BOV or Honda ATV between 1980 / 1990
- Have a bicycle w/ spare parts.
- Adopt technology from the 1700's and 1800's.
- Learn Bushcraft, woodcraft, and primitive skills.

Faraday Cage Design

- Poor man's Faraday Cage. Two or three sizes of aluminum or steel garbage cans that are insulated from each other by non-conductive materials and sealed with conductive tape.
- A good link for making a Faraday cage:
<http://www.askaprep.com/10-faraday-cages-you-can-make-at-home/>



References

NERC, FERC, and other government agencies

[North-American Electricity Reliability Corporation](#) (NERC)

[Federal Energy Regulatory Commission](#) (FERC)

[NOAA Projects](#) (NOAA)

Interesting NOAA, Infragard, and other resources:

<http://highfrontier.org/june-19-2018-emp-commission-reports-continue-dribble>

<https://www.youtube.com/watch?v=s1W1i2YRz4I&vl=en>

<https://www.youtube.com/watch?v=CRL4srLftc0>

<https://www.youtube.com/watch?v=2ynwb4jzDvU>

<https://www.youtube.com/watch?v=Z7vkil-s5m0>

https://www.youtube.com/watch?v=M_M772yIfpg

https://www.youtube.com/watch?v=Pz3nRSufQ_o

Also for the preppers amongst us.

<http://PracticalPreppers.com>

Scott Hunt Engineer775 on Youtube

Arthur Bradly Techprotect bags

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Questions

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