

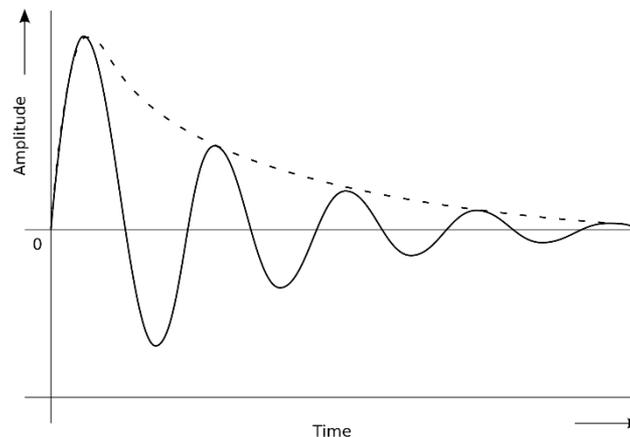
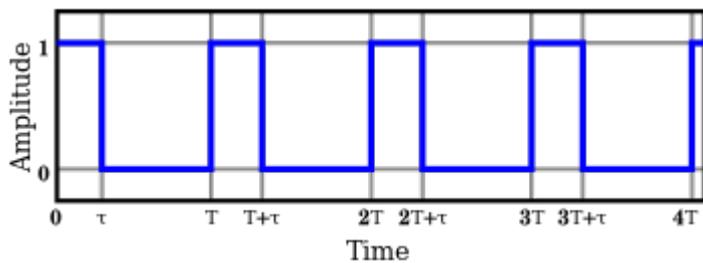
What is Electromagnetic Pulse (EMP) and Why Should We Care?



- What is EMP?
- What damage can it do?
- What can we do to mitigate its impacts?

What is EMP?

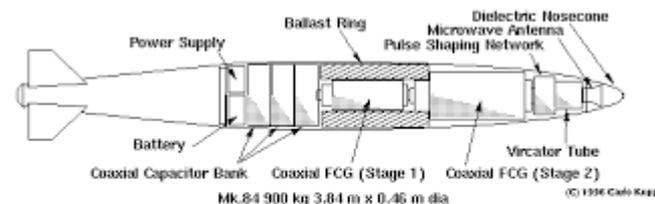
- A short burst of electromagnetic energy
- Characterized by:
 - Type of energy
 - Range of spectrum of frequencies present
 - Pulse waveform: shape, duration, amplitude



- Natural
 - Lightning
 - Electrostatic discharge
 - Meteoric EMP
 - Coronal Mass Ejection (CME)



- Man-made
 - Electric motors
 - Gasoline engine ignition systems
 - Switching action of electrical circuitry
 - Power line surges
 - Nuclear EMP (including HEMP)
 - Non-nuclear electromagnetic pulse weapons

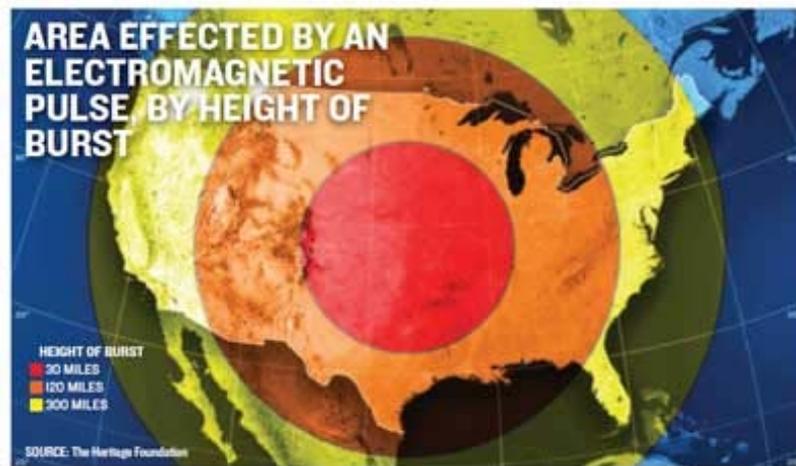


MK.84 900 kg 3.84 m x 0.46 m dia
HIGH POWER MICROWAVE E-BOMB - GENERAL ARRANGMENT MK.84 PACKAGING
WARHEAD USING VIRCATOR AND Z STAGE FLUX COMPRESSION GENERATOR

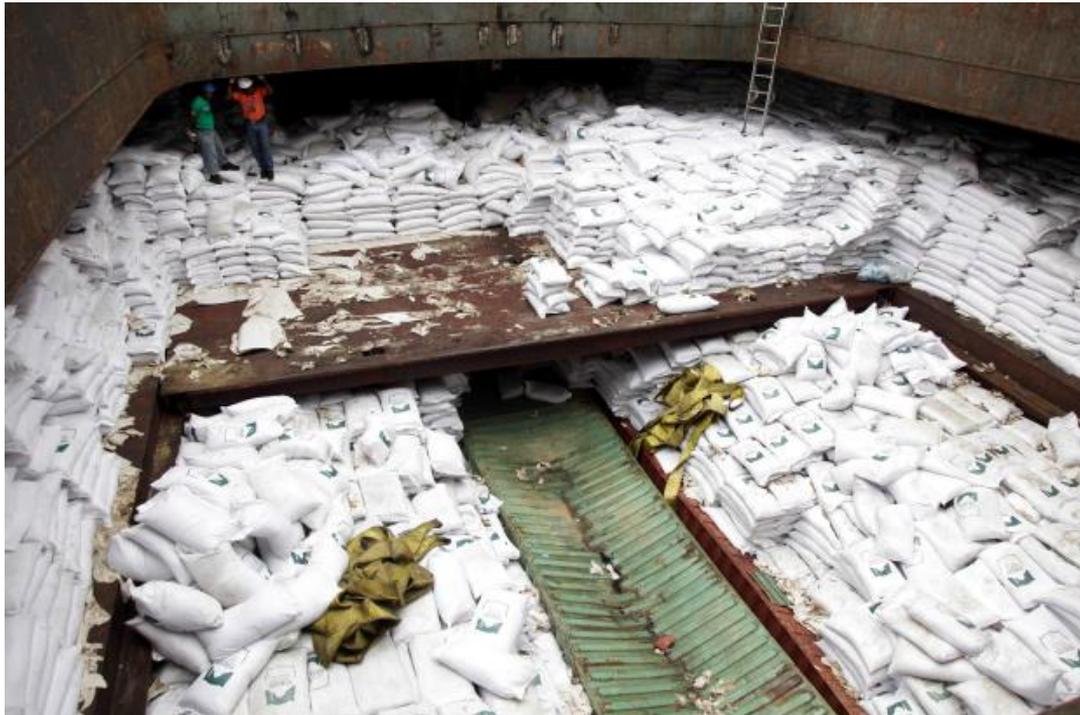
FIG.6 HPM E-BOMB WARHEAD (Mk.84 FORM FACTOR)

High Altitude Nuclear EMP

- Nuclear device detonated in the atmosphere at altitudes of 20 miles to several hundred miles (HEMP)
- Likely fired from off the coast and/or from the south



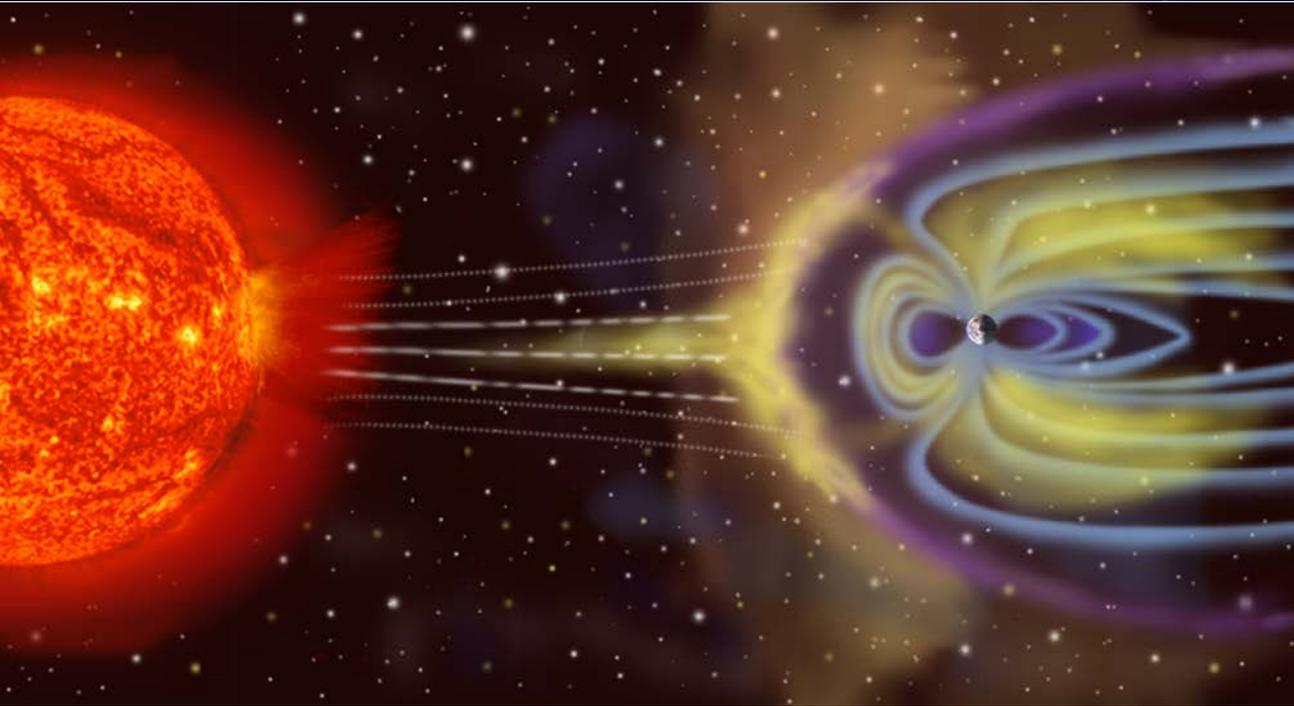
- EMP satellite(s) could already be orbiting
- North Korean missiles and launchers have been intercepted in the Panama Canal



- Solar events (G5) – Coronal mass ejections (CME) – Solar flares - ~100yrs – 1859 Carrington Incident
- Geomagnetic Disturbances (GMD) or storms



Coronal Mass Ejections



[NASA - http://sec.gsfc.nasa.gov/popscise.jpg](http://sec.gsfc.nasa.gov/popscise.jpg)

[Space Weather Prediction Center - NOAA - http://www.swpc.noaa.gov/phenomena/geomagnetic-storms](http://www.swpc.noaa.gov/phenomena/geomagnetic-storms)



- Blackout from HF Radiation
 - Greater threat in the north
 - Greater threat to satellites near the equator
- Long and short wavelength incidents
- Most allow for little or no warning
- Low probability / very high impact

- Nuclear device detonated on land - “EMP Suitcase”
- Radio frequency weapons
- EMP emitting drones
- Cyberattack is the other major threat to the power grid.

EMP SUITCASE

COMPACT 2100 SERIES

APELC proudly introduces the latest compact directed-energy solution. This portable and rugged Gigawatt-class source generates high-amplitude electric fields suitable for affecting electronics and testing system vulnerabilities. The development of APELC's EMP Suitcase was driven by input from DoD groups that required a powerful, reliable, compact EMP source capable of disabling or defeating electronics.

Exterior Dimensions
24.6 x 19.7 x 8.6 in.

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Risks by Perspective and Yield

Dst (nT/min)	EMP sources	Area affected	Notable effects
Hundreds, low thousands	Geomagnetic storms from solar flares or CMEs	Continental or larger	Dangerous overvoltages, transformer burnouts, massive surges
High thousands, ten thousands	Lightning at about 1 km distance	Highly local	Surges, blown fuses, damage to connected electrical equipment
Hundred thousands	Lightning at about 200 m	Highly local	Computer crashes (possibly permanent damage), blown up power transformers, power outages in parts of city. Fires around electrical equipment.
Millions and tens of millions	Nuclear EMPs at high altitude, nuclear EMPs from close-by small nuclear weapons, lightning within a few meters	Varies	Permanent damage to microelectronics, some erasure and corruption of magnetic media
Hundreds of millions and up	Conventional EMP weapons	Very small	Disabled vehicles including operating aircraft; numerous small fires, and arcing wherever there's metal

Source: "EMP, Debunked: The Jolt That Could Fry the Cloud", John Barnes, Information Week, 9/15/2014

Lightning? Yes, Lightning...

If you're not already protected against lightning strikes, you're already in a lot of trouble.



So what are the actual risks?

- Lightning produces EMP's. It does not require a direct strike. Protection is an immediate necessity. Biggest and most common risk.
- Geomagnetic storms brought on by CME's do occur, this happens, the damage and disruption potential has been demonstrated. Find solutions to mitigate the problem and increase chances of recovery and reducing downtime. Medium to low risk.
- Small area, easily carried/transported weapons are a significant risk. The technology can be built in a garage. It can be used to circumvent security systems or cause havoc on power, water, or any aspect of infrastructure. Medium to low risk.
- Nuclear weapons, are not a likely threat. YES there are suspect leaders in the world but the only time a nuclear weapon was used in direct aggression was in 1945 and never have been since then. Very low risk.

If you can protect your infrastructure against a tactical or even strategic nuclear event, then you can survive almost anything.

But is it worth it?



- Maybe
- Last government test only tested cars 1987-2002. 15% failed totally
- Cars have developed far more complex and integrated electrical systems since 2002, the latest model year tested.
- Most modern diesel vehicles are just as technologically advanced and electronically complex
- Modern motorcycles

- Radios HAM, Consumer, etc
- All wireless devices
 - Phones
 - WiFi

Basically every device using new submicron chips and with an antenna or without a metal case. External power cords act like an antenna. Even if powered off!

What to do?

- Basic, easy, inexpensive solution.



Seal with Aluminum HVAC
tape

Put your radio/electronics in cardboard box to
insulate from metal can.

Off grid ham ideas

- Use old microwave



- Use old refrigerator



- Metal filing cabinets

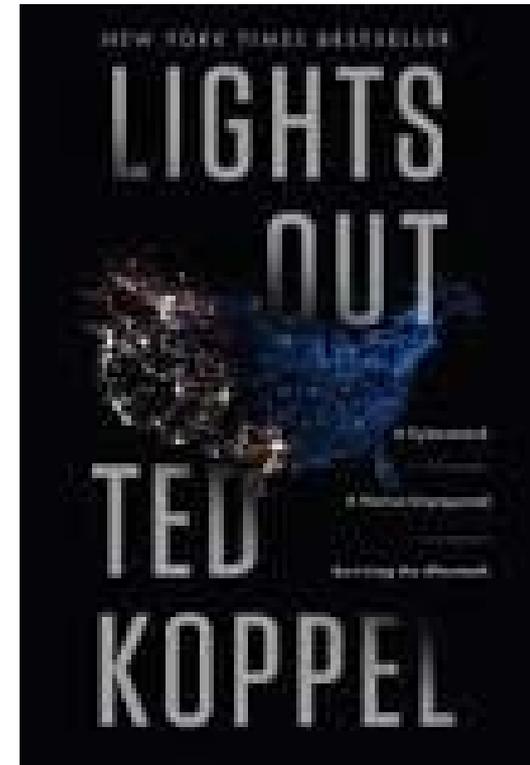
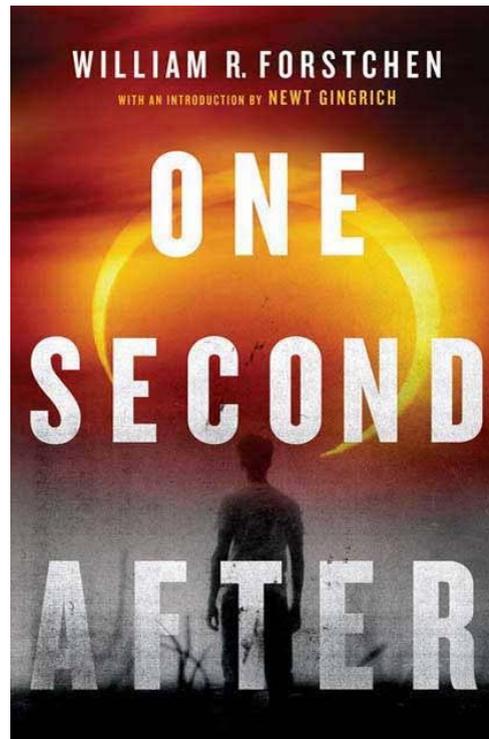


- **Lights Out: A Cyberattack, A Nation Unprepared, Surviving the Aftermath**

by: *Ted Koppel*

- **One Second After**

by: *William R. Forstchen*



- Peter Pry, a defense analyst
- EMP.NEWS
- For the real story on the EMP threat, see the unclassified EMP Commission reports at www.firstempcommission.org.
- International Journal of Research Studies in Electrical and Electronics Engineering(IJRSEEE)
- <https://www.arcjournals.org/pdfs/ijrseee/v4-i2/1.pdf>

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QUESTIONS?

