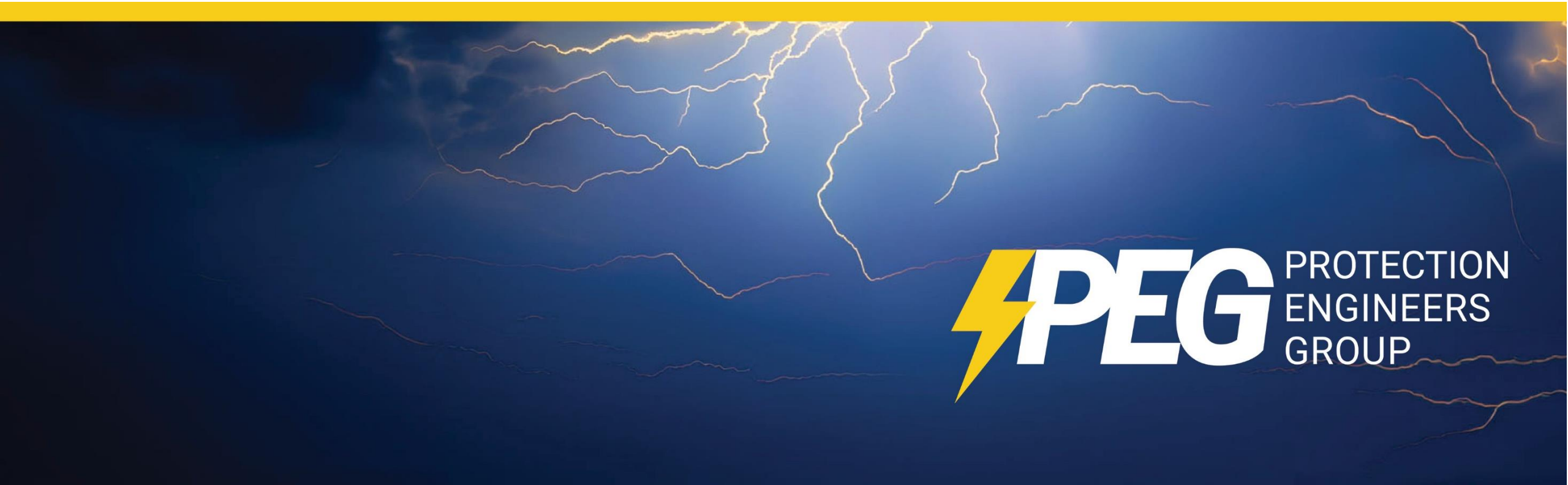
EMP/HEMP Resilience

Protecting Civilian Critical Infrastructure Facilities



EMP/HEMP Threat to Critical Infrastructure

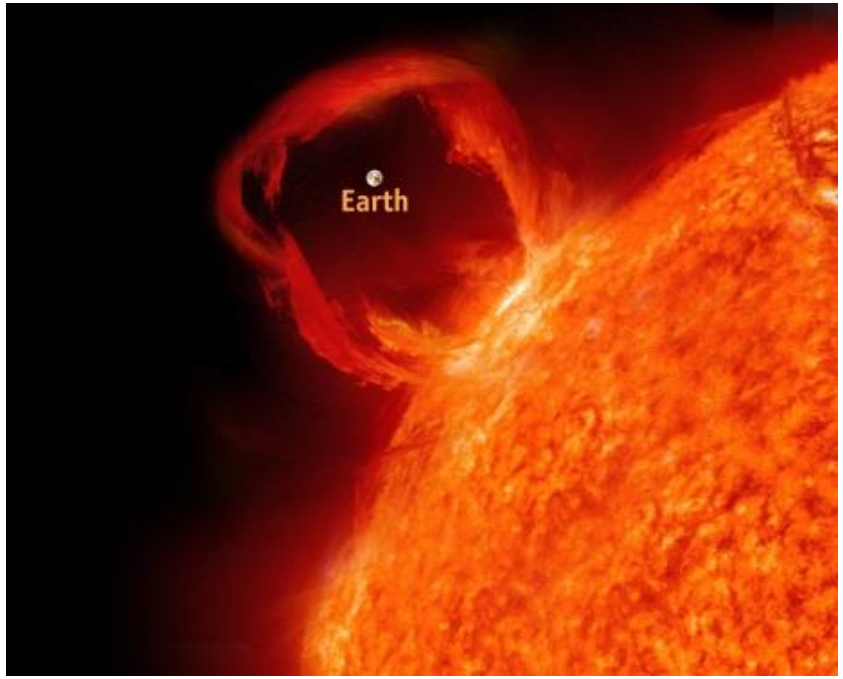
1. What is the Threat?
2. EMP/HEMP Description
    - Conducted
    - Radiated
3. Mil-Std Level Protection vs. Civilian Critical Infrastructure
4. Protecting (Hardening) Facilities at the Appropriate Level

The REAL Electromagnetic Threats

- **Solar Storms: Re-occurring natural events – Probable**
  - Solar storms occur regularly
  - Solar storms affecting critical infrastructure occur less often
    e.g., Carrington Event 1859
- **IEMI: Man-made (directed energy weapons) – Probable, but less likely than Solar Event**
  - What is IEMI (Intentional Electromagnetic Interference)?
    IEMI delivers damaging Electro-Magnetic Pulses to facilities via radiated fields or conducted energy through power lines. IEMI devices are small enough to mount on an innocuous vehicle that can be positioned adjacent to telecom or utility facility during an attack.
- **Nuclear High-Altitude Detonation – Possible, but not probable**
- **Nuclear Surface Detonation (i.e., Nuclear WWIII) – Possible, but least probable**

The Solar Threat – High Impact, Medium Probability

- Has happened in the past – 1859,1903, 1921,1940,1972,1989, 2001, 2003, 2024…
- Different intensities of Corona Mass Ejections (CME) occur regularly.
- An intense CME or a solar flare at the right time could have significant impact on electronic equipment, affecting both telecom and the utility industry.



The IEMI Threat – Regional Impact, Lower Probability than Solar Event

- Most likely to be a targeted attack.
- Either a Nation State or terrorist organization will use covered trucks or trailers to pulse civilian critical infrastructure.
- Coordinated, simultaneous attacks at substations could bring down a regional utility grid.

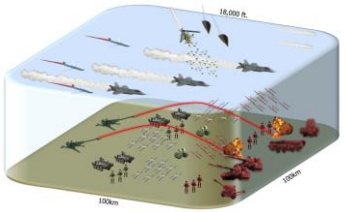
The Nuclear Threat – Highest Impact-Lowest Probability

- Many presentations show this image. **This is NOT** the nuclear explosion that will generate a HEMP event that affects critical infrastructure!

- This photo from Starfish Prime shows a nuclear detonation in the upper atmosphere. **This will be** the device that widely affects critical civilian infrastructure.

Military Versus Civilian Critical Infrastructure

- Military is prepared to operate in battlefield conditions
  - Absolutely no interruption in operations can occur
    - Any interruption can put the mission and lives at risk



- Critical Civilian Infrastructure
  - Outages occur during emergency events:
    - Floods, hurricanes, tornadoes, fires, snowstorms, etc.

  - During emergency events equipment may go down, but must restart quickly or be rebootable
    - This is normal and companies have built operations to enable restarts
    - Disruption is acceptable, damage is not.

What Level Of Protection Is Required?

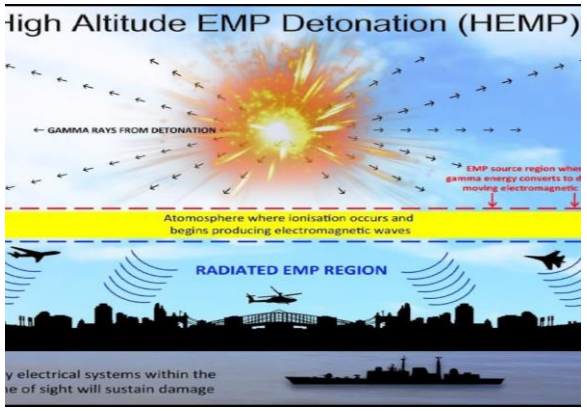
- A short downtime during an emergency is allowable, significantly changing the level of protection needed.
  - ***Mil-Std level of hardening is not required!***
- EMP assessment starts with a look at what needs to be protected:
  - Identify the threat
    - Conducted Pulse
    - Radiated Pulse
  - Identify the risk to equipment
    - What is the damage threshold?
    - What is the disruption threshold?
    - Is the equipment critical to sustained operation?
  - Assess the level of existing electromagnetic protection in the facility.
  - Identify the improvements necessary to bring the facility to the level of resiliency that is needed.

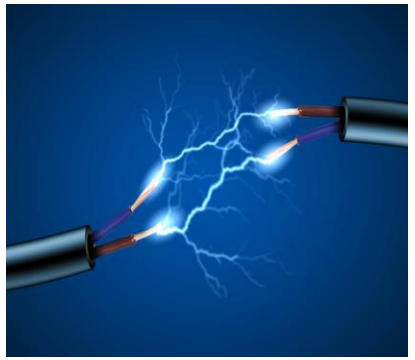
Radiated and Conducted Pulse

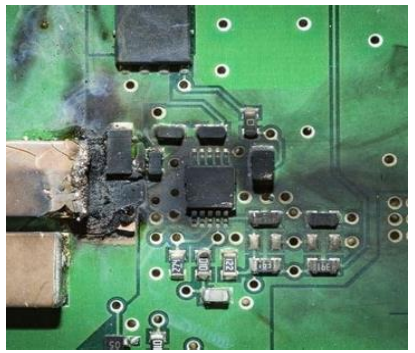
An EMP affects facilities in two different ways:

1. **Radiated Fields (the lesser threat)**
   - Pulse energy travels through the atmosphere and penetrates structures to affect equipment.
     - Weakens with distance and attenuates when passing through building materials.
   - Remediate with a combination of additional shielding, closure of apertures, grounding, relocation of equipment to better protected space.
   - Latest ATIS EMP standard recommends 40 dB of shielding.
2. **Conducted Pulse (the greater threat)**
   - The pulse energy couples onto conductors and travels full strength into buildings and equipment with little degradation in energy.
   - Conductors become a superhighway through the grid to damage the equipment.
     - It does not weaken significantly.
   - Remediate with a combination of utility-line EMP filters, bonding/grounding, secondary surge protection, *DASH*, removal of unused cables and equipment.

If budget only allows for protection against one effect, protect against conducted pulse over radiated fields.



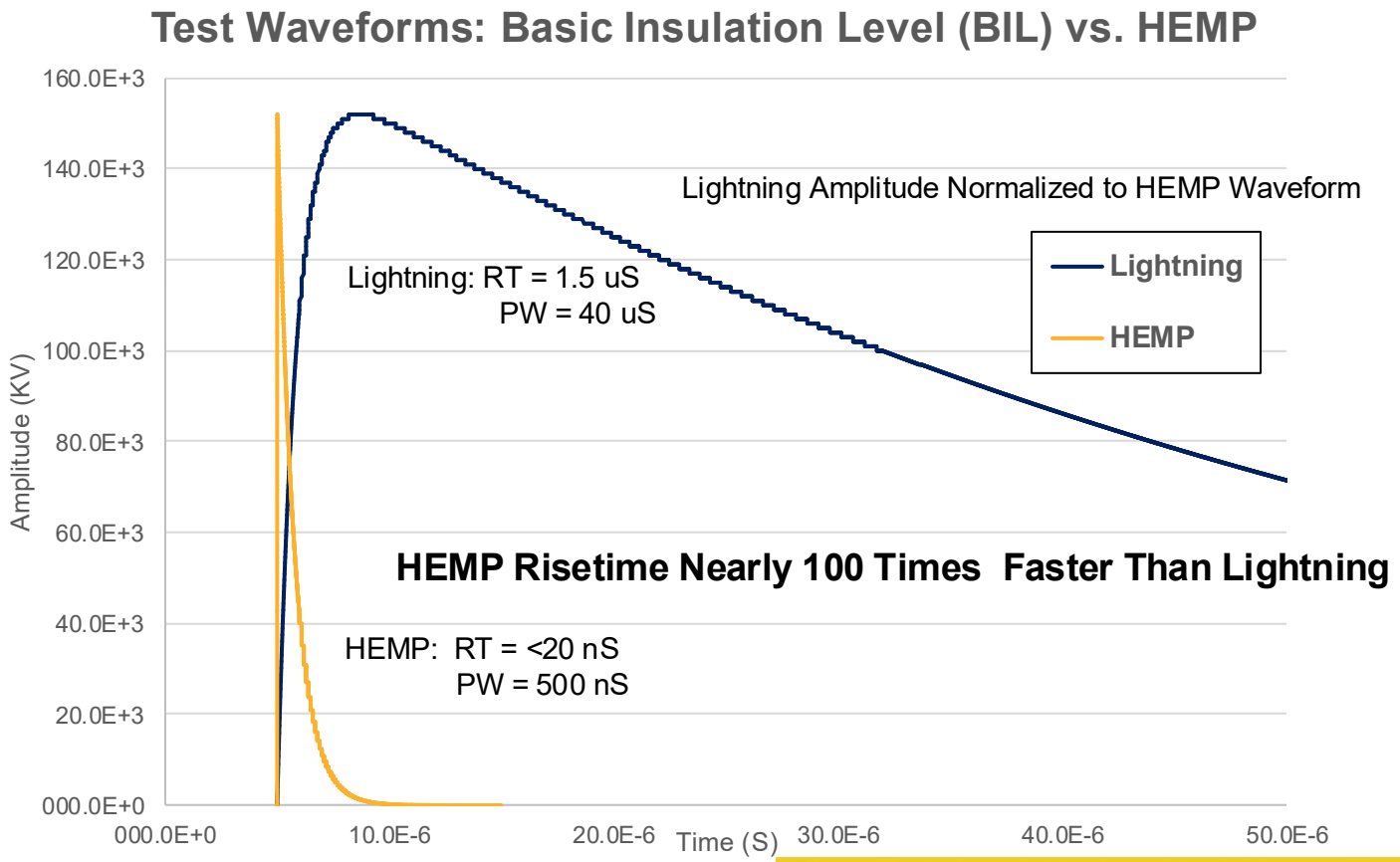




EMP Conducted Pulse Protection Vs. Lightning Protection

Radiated EMP couples onto a conductor and then penetrates into the facility.

- **Lightning Surge Protection**
  - Lightning surge protection will not stop an EMP pulse on its own – it does not respond quickly enough to the fast rise time of EMP.
- **EMP/HEMP Filter**
  - Reduces the pulse to less than a plus 10-amp residual and overvoltage of approximately 15% to 20%.
- **Bonding/Grounding**
  - Proper bonding and grounding always helps but is insufficient on its own to stop an EMP conducted pulse.



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Protecting Facilities

Assessing Electromagnetic Resiliency in Existing Buildings

- **Identify** vulnerabilities – apertures, deferred maintenance, conductor penetrations, RIP'd equipment and cabling
- **Benchmark** existing shielding effectiveness – compare to the ATIS 40 dB standard.
- **Evaluate** what level of protection is required for each system to remain undamaged even if disrupted.
- **Identify** most cost-effective approaches to protecting critical services – ubiquitous shielding improvements are probably not necessary. Mil-Stds definitely not necessary for commercial telecommunications.

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Protecting Facilities (Continued)

***Improving* Electromagnetic Resiliency in Existing Buildings**

- **Change out** susceptible items to non-susceptible configurations and equipment; e.g., copper wire PLC to fiber optic.
- **Protect** incoming power, control, telecom and data lines from conducted pulse by installing EMP filters.
- **Relocate** critical equipment to building interiors to improve shielding.
- **Remove** unused cable and equipment that could become conductors for a pulse.
- **Train** existing personnel to be EMP-literate to assess facility conditions OR find an SME who will provide a realistic evaluation to harden facilities to the appropriate level and provide on-going support.
  - Experience has taught us that SMEs are required to ensure a successful outcome to evaluate and harden facilities and equipment.

Any steps towards resiliency improves survivability for continued operations.

- **Budget** incremental resiliency improvements as part of the maintenance cycle.