WHAT IS AN EMP? ELECTROMAGNETIC PULSE EFFECTS AND PREP

An electromagnetic pulse (EMP) is a burst of energy from a nuclear explosion that can damage or disrupt electronics and cause power outages. FEMA says it is not a direct physical hazard to people, most battery-operated devices should work after being turned off and on again, and preparing for it looks a lot like preparing for a long power outage.

Reviewed October 29, 2026

FEMA defines an electromagnetic pulse as “a sharp pulse of radiofrequency (long wavelength) electromagnetic radiation produced when an explosion occurs near the Earth’s surface or at high altitudes”, whose electric and magnetic fields can damage unprotected electronics. This page sticks to what federal sources say an EMP can and cannot do.

IS AN EMP DANGEROUS TO PEOPLE?

Not directly. FEMA’s planning guidance says that, “although not a direct physical hazard to people, EMPs can disrupt or damage some electronic equipment within a few miles” of a detonation (FEMA). The dangers to people from a nuclear explosion are the blast, heat, fires, and radiation, including fallout. The protective actions for those do not change: get inside, stay inside, and stay tuned. See the first 72 hours.

TWO KINDS OF NUCLEAR EMP

FEMA’s guidance separates EMP by the height of the explosion (FEMA, Appendix 1.1).

Ground-level or low-altitude detonation

A detonation less than about 3 miles above the ground produces what FEMA calls a source region EMP. Its electric fields “can be very high but fall off rapidly with distance from the detonation,” and the pulse typically lasts less than a millisecond. FEMA describes two effects:

- **Direct effects on electronics.** The pulse induces voltage on the internal wires of equipment, which “may disable or damage equipment.” FEMA says these damaging effects extend roughly as far as the severe damage zone from the blast, and will only affect some of the equipment in that area.

- **Surges on power lines.** Long power lines near the detonation pick up large voltage and current surges that can travel well beyond the blast area. FEMA says surges can damage unprotected equipment plugged into wall sockets up to 9 miles away, and that substation damage or tripped breakers can occur farther out depending on how the grid is laid out.

FEMA also notes that this kind of EMP is only weakly tied to the size of the weapon, so these distances "change very little for yields ranging from 10 kT to 1000 kT," unlike blast damage.

High-altitude EMP (HEMP)

A detonation more than about 19 miles (30 km) up can produce a high-altitude EMP. FEMA says its first, fast component can be a strong electric field over a large area, "perhaps the size of Nebraska or a bit larger," and that "unprotected electronic devices may be damaged or electrically disrupted, requiring reset or power cycling, though devices connected to long conductors are at greater risk" (FEMA, Appendix 1.1). A later, slow component behaves like a geomagnetic storm (below). FEMA's guidance focuses on low-altitude detonations and covers HEMP only briefly.

CISA, the federal agency for critical infrastructure, says high-altitude EMP attacks are of most concern and that EMPs can also come from specialized conventional munitions or non-nuclear directed energy devices.

SOLAR STORMS: A RELATED NATURAL RISK

The sun can cause a similar effect. FEMA explains that charged particles from the sun, such as a coronal mass ejection, can cause a geomagnetic disturbance (GMD) that creates low-frequency electric fields along long conductors like transmission lines. GMD events "can last several minutes, hours, or days and can cover large areas," and FEMA says "the primary GMD threat is to large power transformers overheating".

WHAT AN EMP CAN AFFECT

CISA lists the infrastructure at risk from EMP as including the electrical grid, communications equipment, water and wastewater systems, and transportation. Under Executive Order 13865, DHS coordinates national resilience to EMP and geomagnetic disturbance events.

The Government Accountability Office reviewed federal work on these risks in 2016. It found that electromagnetic risks from "a man-made EMP or a naturally occurring solar weather event" could lead to power outages over broad geographic areas for extended durations. GAO found federal agencies had taken various actions, and also found gaps in how DHS and DOE coordinate and identify critical grid assets.

WHAT HAPPENS TO YOUR DEVICES AND POWER

For a low-altitude detonation, FEMA's planning guidance gives a fairly specific picture (FEMA):

- **Most battery-operated equipment.** In the moderate damage zone around the blast, FEMA says the EMP may damage or upset some electronics, but "most battery-operated equipment should work after power cycling (turning off, then on again)." In the light damage zone farther out, most battery-operated equipment "will not be damaged, but some equipment may lose some functionality."
- **Things plugged into the wall.** "Equipment plugged into wall outlets without a surge protector may be damaged due to power surges."
- **Radios.** "Commercial band AM/FM radios will be able to receive signals from transmitters outside the area."
- **Phones and electronics.** Most electronic equipment will work after a reset, and permanent damage to electronics will generally be limited to the moderate damage zone. FEMA expects downed power and phone lines in the damaged area to keep cellphones from connecting even if the phones work.
- **The power grid.** Power outages are likely and can cascade well beyond the damage zones. FEMA says temporary outages, from hours to days, may extend tens of miles beyond the blast area, and that utilities can restore power to undamaged areas "typically hours to a few days." Transformer damage, which is hard to repair quickly, "is generally limited to a few miles from ground zero."

CDC gives the same household advice: an EMP "can damage electronic devices," and if a battery device stops working, take the batteries out, put them back in, and restart it. Other devices may need switches or breakers reset. CDC adds: "Do not go outside to reset breakers."

HOW TO PREPARE FOR AN EMP

The sources above point to the same steps you would take for any long power outage.

1. **Keep a battery-powered or hand-crank radio.** Ready.gov says such a radio "will continue to work if other forms of communication fail", and FEMA expects AM/FM broadcasts from outside the affected area to keep reaching you. See emergency radio and alerts.
2. **Keep extra batteries.** Ready.gov's kit includes extra batteries and a backup battery for your phone.
3. **Know to power cycle.** If a battery device fails, take out the batteries, put them back, and restart it, per CDC.
4. **Use surge protection on electronics you care about.** FEMA's basic, low-cost measures for organizations include using at least a lightning-rated surge protection device on power cords, antenna lines, and data cables, and, when warned, unplugging spare equipment and turning off equipment not in use. FEMA describes these as improving the odds that equipment works outside the immediate damage areas.

5. **Plan for days without grid power.** FEMA calls backup power, such as a generator or an uninterruptible power supply, the most important resiliency element for systems that must keep running. For a household, that means the same planning as the grid track: start with the first week without power, then home backup power and portable power stations. If you run a generator, read generator safety first.

SOURCE

This page covers only what FEMA, CISA, CDC, and GAO state. For a low-altitude detonation, FEMA describes damage to some electronics, power surges, and outages, with power restored to undamaged areas typically in hours to a few days.

NEXT STEPS

- What to do after a detonation: The first 72 hours
- Stay informed without power: Emergency radio and alerts
- Prepare for a long outage: The first week without power

TRACK	Nuclear emergency
SHEET	10 of 11
REVIEWED	October 29, 2026

COMPILED FROM THESE SOURCES

1. FEMA, Planning Guidance for Response to a Nuclear Detonation, Third Edition (2022)
2. CISA, Electromagnetic Pulse and Geomagnetic Disturbance
3. GAO, Critical Infrastructure Protection: Federal Agencies Have Taken Actions to Address Electromagnetic Risks (GAO-16-243)
4. CDC, What to Do: Stay Tuned
5. Ready.gov, Radiation Emergencies (Nuclear Explosion)
6. Ready.gov, Build a Kit

Every safety claim on this sheet links to its primary source.