CASCADIA REGION EARTHQUAKE WORKGROUP
CREW
AHEAD OF THE WAVE

Emergency Power for Hospitals
Preparing for Cascadia

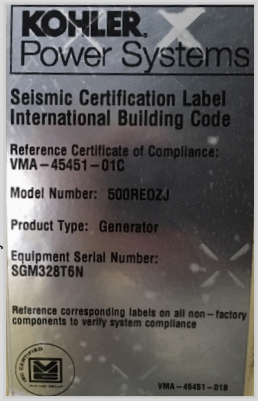


Photo: Patrick Kirby

Hospital executives can improve the reliability of their emergency power systems by installing seismically certified generators (above).

In this fact sheet:

- **How to make sure your hospital has enough power to function after a Cascadia quake**
- **What hospital leaders in Oregon need to know to plan for emergency power**
- **Resources and tips to help you develop a robust power system**

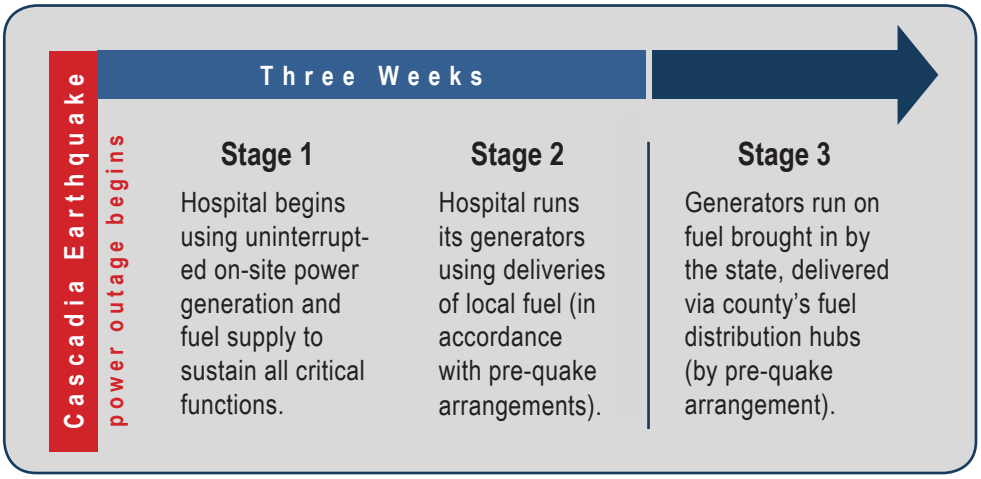
Lessons for Hospitals from Past Earthquakes

Hospitals provide critical services during disasters, so it's imperative that they continue to function with minimal interruption. Preparing for earthquakes starts with learning from past events. California's magnitude 6.7 Northridge earthquake in 1994, for instance, caused widespread power outages, exposing the vulnerability of the large electrical networks on which hospitals depend. Recent disasters, including Chile's M8.8 earthquake in 2010 and New Zealand's M6.1 quake in 2011, reinforced the need for uninterrupted emergency power in hospitals and revealed potential vulnerabilities of backup systems—lessons that hospital leaders in the Pacific Northwest can use to improve the reliability of their emergency power systems before the region's next magnitude 9.0 Cascadia subduction zone earthquake and tsunami strike.

What Will Hospitals Face When Cascadia Breaks?

Hospitals across western Oregon should expect a major Cascadia earthquake to cripple energy infrastructure, causing a widespread and prolonged electrical outage and fuel shortages. The shaking will be most severe along the coast, and tsunami waves will devastate low-lying coastal areas. Damage to transportation routes linking coast and interior will inhibit delivery of fuel supplies and slow the restoration of primary electrical power. The coast will be cut off initially from all but local emergency response services. The state of Oregon plans to deliver emergency supplies by air and water until ground routes become passable, but this will take time to initiate and supplies will be limited. Oregon's coastal hospitals will have to depend on local sources of fuel for three weeks; they will likely have to rely on backup power for months.

Oregon's coastal hospitals must prepare to sustain power using on-site and local generation, possibly for months; they must rely on their own and local fuel supplies for three weeks (see the Oregon Fuel Action Plan *for details).*



OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES 1937

Oregon Health Authority

Strategy for Post-Earthquake Emergency Power at Oregon Hospitals

Hospitals in western Oregon can improve their resilience by envisioning their post-earthquake emergency power and fuel strategy in three stages and by taking steps now to meet the demands of each stage.

TO PREPARE FOR:	LOCAL/REGIONAL HOSPITAL LEADERSHIP SHOULD:
Weeks 1 – 3 **Stage 1** Hospital switches to on-site emergency power if main power fails; hospital supplies itself with uninterrupted power by running generators using on-site fuel sources.	☐ Reduce the risk of power outages by building redundancy into the electrical system (such as two separate electrical feeder lines into the hospital). ☐ Identify critical functions and install a seismically designed emergency power system sufficient to run them (preferably, 100% of normal load). This should include: • Seismically certified emergency generators, with earthquake-ready components (anchored generator, well-braced batteries, flexible connections for exhaust system, switchgear, etc.). • Fuel storage tanks with earthquake-ready components (fuel pumps, fuel lines, flexible connections, etc.). • An adequate on-site supply of fuel and maintenance supplies (filters). • Earthquake-resistant housing for emergency power equipment to protect against structural and nonstructural damage.
Stage 2 Hospital continues to run generators using local supplies of fuel for three weeks.	☐ Work in advance with county emergency managers and local vendors to plan for deliveries from nearby secure, earthquake-resistant fuel depots (such as non-retail card-lock facilities and retail gas stations) and servicing by qualified technicians.
After 3RD Week **Stage 3** Hospital continues to run generators with fuel sent by State of Oregon to county-designated fuel points of distribution (FPODs).	☐ Prearrange with county emergency managers for the hospital to receive fuel. ☐ Talk to the county about their emergency fuel management plan.* *See an example—*Washington County Emergency Fuel Management Plan*: https://www.co.washington.or.us/EmergencyManagement/plans-and-agreements.cfm

Did You Know?

In line with the *Oregon Fuel Action Plan*, county emergency managers will:

- **Identify critical facilities with priority to receive emergency fuel deliveries when fuel is available.**
- **Designate fuel points of distribution for fuel deliveries by the state.**
- **Identify delivery methods.**
- **Prioritize repair of roads to access critical facilities.**

Emergency generators are best suited to short-term use; recovery of electrical power after a Cascadia event could take months. A local resilient power source could be a better long-term solution. (Learn more on Page 4.)

Photo: DOGAMI

Example of flexible connections.

Nuts and Bolts

The cause of emergency power system failures in past earthquakes is typically nonstructural, including poorly anchored fuel tanks, batteries, and exhaust stacks. When installing seismically certified equipment, use flexible connections and make sure all parts of the system are properly selected, installed, and braced. Arrange for qualified experts to conduct a comprehensive seismic assessment of the emergency power system and mitigate deficiencies. Also, ask experts to examine both site and buildings using the Hospital Seismic Evaluation Checklist in section 2.5 of FEMA 577 *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings* (2007).

Features of a Resilient Emergency Power System

PeaceHealth Peace Harbor Medical Center in Florence, Oregon, applied best practices for earthquake preparedness when installing its on-site emergency power system:

- The hospital campus is served by two separate electrical feeds, and the local utility, Central Lincoln PUD, can switch between the two.
- The emergency power system (including generator, fuel system, and switching gear) was specifically designed by a qualified engineer to be operational after a Cascadia earthquake.
- The emergency power system supplies nearly all hospital functions, including the kitchens. (Only a section of the cafeteria is excluded.)
- The hospital can monitor loads on each branch and subbranch of the power system; and the system is designed to make switching easy to limit the load and supply power to essential functions only.

The hospital's on-site fuel tank is properly anchored and fuel line connections are flexible. (Photo: DOGAMI)

Tips & Tools

Is your generator seismically certified? Is your emergency power system ready to supply the hospital?

Use FEMA's Checklist for Emergency Planning Prior to Emergency or Disaster to evaluate the status of your system. (Find this and related checklists in FEMA P-1019, Appendix D).

Meeting Hospitals' Emergency Power Needs

Hospitals should develop emergency power systems to meet the objectives in their disaster management plans. At a minimum, they should identify the amount of power needed to sustain critical functions. To be fully operational, they must develop emergency power systems that cover 100 percent of their normal electrical loads: This may require designing new systems or upgrading existing systems above the minimum levels specified in building codes.

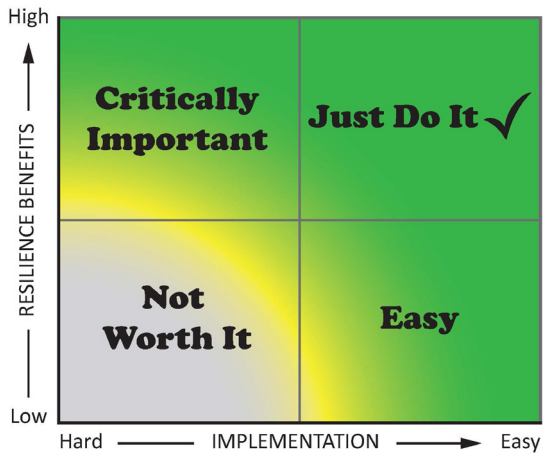
Determining how much emergency power the hospital requires starts with establishing priorities. A good first step is to group medical equipment and support facilities into three power-distribution branches: the equipment branch, critical branch, and life-safety branch (for guidance, see FEMA P-1019, Appendix A; and NFPA 99 Healthcare Facilities Code).

Upgrading Existing Hospitals

To remain functional after a Cascadia earthquake, new hospitals must be built to exceed current code requirements; existing hospitals can upgrade structures and systems incrementally to achieve similar goals.

The diagram (right) shows how to rank and implement proposed upgrades to achieve the greatest impact using available resources.

Hospitals in Oregon can apply to the Seismic Rehabilitation Grant Program for up to $2.5 million to support upgrades: www.orinfrastructure.org/Infrastructure-Programs/Seismic-Rehab/



Resilient Local Power

Most hospitals depend on "centralized generation," making them part of a region-spanning network or "macrogrid." A Cascadia earthquake will damage this system, and it's expected to take months to restore power. Hospitals should therefore consider a "distributed generation" option—a source of local power that is sufficient to supply the hospital indefinitely. Ideally, a local source is coupled with a microgrid (which can be disconnected from the macrogrid when necessary) and with Smart Grid technologies (www.smartgrid.gov).

Local Power Sources in Tillamook County, Oregon

A local source of power is already at work in Tillamook County: Bio-digestors. The digestors turn dairy farm manure into electrical power. Such local generation could be developed as part of a microgrid and could supply the local hospital with power when the macrogrid is down.

Building Resilience through Partnerships

The local power company is a key partner. Ask your company:

- If it has assessed its seismic vulnerability and developed a mitigation plan.
- If it is considering options for local power generation.

For example, Tillamook PUD is exploring alternative energy sources and a microgrid for Tillamook Regional Medical Center and other critical facilities.

Hospitals rely on local fuel suppliers. Ask them about their preparations for earthquakes and other emergencies.

Serving the community in a crisis is a priority for the owners of Sheldon Oil Co. in Tillamook. After a lengthy power outage in 2006 left them hand-pumping fuel for emergency services and others, they installed emergency generators and transfer switches (photo) at their facilities.


Photo: DOGAMI

Tips & Tools

If a hospital's generators fail in a crisis, FEMA and the U.S. Army Corps of Engineers may provide a back-up. Pre-register now using EPFAT (Emergency Power Facility Assessment Tool). Keep in mind that earthquake damage to roads and other routes may delay delivery.

Additional Resources

FEMA P-1019: *Emergency Power Systems for Critical Facilities* (2014).

FEMA 577: *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds* (2007).

Emergency Power Facility Assessment Tool (EPFAT). https://epfat.usace.army.mil/

Emergency Water for Hospitals: Preparing for Cascadia (CREW Fact Sheet #11).

Oregon

Earthquake Risk Study for Oregon's Critical Energy Infrastructure Hub (DOGAMI Open-File Report 0-13-09). www.oregongeology.org/pubs/ofr/p-O-13-09.htm

Oregon Coastal Hospitals Preparing for Cascadia (DOGAMI Open-File Report 0-18-03) [see especially Appendix A: Technical Resources List for Hospitals]. www.oregongeology.org/pubs/ofr/O-18-03_report.pdf

Oregon Fuel Action Plan (October 2017). Oregon Department of Energy. www.oregon.gov/energy/facilities-safety/safety/Documents/Oregon-Fuel-Action-Plan.pdf

Oregon Health Authority (OHA) Prepare for Earthquakes website. http://public.health.oregon.gov/Preparedness/Prepare/Pages/PrepareForEarthquake.aspx