POWERED For Patients
Safeguarding Emergency Power for Critical Healthcare Facilities

Powered for Patients is pleased to provide this document which includes the universally applicable elements of the Los Angeles County EMS Agency's Emergency Power Resilience Playbook. These resources can be put to use today by jurisdictions interested in boosting emergency power resilience for hospitals and nursing homes. Some of these resources include references to Los Angeles County. Jurisdictions should ignore these references and focus on the content within these documents they can use to bolster emergency power resilience. The following resources are included in the downloadable PDF shown below:

- Outdated Generators: A Risk To Patient Safety
- Understanding the Value of Emergency Power Quick Connects
- FEMA D-1 Checklist For Emergency Power Planning Prior To Power Outage
- FEMA D-2 Checklist For Emergency Power Planning During Power Outage
- FEMA D-3 Checklist For Emergency Power Planning Following Power Outage
- The 10 Most Common Causes of Generator Failure
- Generator Fuel Consumption Rate Chart

The following additional resources are provided as downloadable Word documents so hospital personnel can more easily use them to collect important data. These Word documents can be accessed on the Powered for Patients website; under the Resources Tab, click on Reference Materials and Assessment Tools and these Word documents are the last five resources on this page.

- Emergency Power Assessment for Hospitals
- Emergency Power Assessment for SNFs
- Post-Disaster Hotwash
- Key Emergency Power Contacts Worksheet
- Spare Parts Inventory & Fuel Consumption Rates

Public health officials, emergency managers or hospital personnel with questions about how to best use these resources can contact P4P project director Eric Cote at cote@poweredforpatients.org, or by calling 401-374-8500.

Emergency Power Protection Resource Kit

Includes Key Appendix Content from the LA County EMS Agency's Emergency Power Resilience Playbook

EMERGENCY MEDICAL SERVICES AGENCY
LOS ANGELES COUNTY

Los Angeles County Healthcare Facility

Emergency Power Resilience Playbook

A New Resource to Safeguard Emergency Power During Power Outages

First Edition

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Approved:

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Appendix D - Outdated Generators: A Risk to Patient Safety

Among the key findings of the LAC EMS Agency's emergency power preparedness initiative is the significant number of hospitals operating with outdated generators in LAC. The 2021 census of hospital emergency power systems conducted by the LAC EMS Agency showed that over 30 percent of the 271 generators captured in the census were in excess of 30 years of age, considered the useful life of a generator[2]. For the single-generator acute care hospitals, the percentage of outdated generators was more than double, with some single-generator facilities relying on generators in excess of 50 and even 60 years of age. No federal or state requirements limit the age of a hospital generator if the generator can meet minimum testing requirements. However, these testing requirements do not represent the true challenge an outdated generator would face if required to operate for many hours during an extended outage. Since single-generator facilities lack redundant emergency power, patients in these facilities face a higher risk of emergency evacuation should the facility's only generator fail.

This 50-plus year-old generator was previously relied on by a hospital in LAC that recently invested in installing a new generator.

Given the age of generators in many of the single-generator hospitals, and the lack of redundant emergency power in these facilities, the LAC EMS Agency offered one time funding in 2021 for single-generator hospitals participating in the U.S. Department of Health and Human Services Hospital Preparedness Program to install real-time emergency power system monitoring technology. This technology acts like a heart monitor for a patient, providing automated, 24/7, real-time alerts to designated individuals anytime emergency power is activated or experiences a problem while operating. When these alerts are provided to generator service providers and designated government officials, generator repair or deployment of temporary government generators can be accelerated, minimizing the risk of an emergency evacuation. As of the publication date of this Playbook, two of the county's single-generator hospitals had taken advantage of the LAC EMS Agency's offer to supply the real-time generator monitoring technology.

[2] The 30-year useful life of a generator is detailed in *Roadmap to Resiliency*, a white paper on emergency power resilience published in 2017 by the American Society for Healthcare Engineering (ASHE), and Powered for Patients.

Appendix F - Protocol for Requesting Deployment of Temporary Government Generators During an Emergency

Any hospital or sub-acute SNF in LAC that needs to request the deployment of a temporary government generator during a power outage will have to submit a resource request through ReddiNet. The resource request will require facilities to verify that they could not secure a temporary replacement generator through the private sector. The LAC EMS Agency's Medical Alert Center personnel will receive these requests in real-time and liaise with facility personnel and government organizations to help fulfill requests for temporary generators. If ReddiNet is unavailable, use the LAC EMS Agency Medical and Health Resource Request form included in Appendix Q.

As noted previously in this Playbook, in addition to the LAC EMS Agency, other LAC agencies and the Cities of Long Beach and Los Angeles each have a cache of temporary generators that can be deployed to healthcare facilities facing a threat to emergency power during an outage. These assets are intended to support all critical infrastructure facilities that rely on emergency power during an outage which means hospitals and sub-acute SNFs cannot be guaranteed access to these generators. When requests for these assets are made, the LAC EMS Agency will work with the custodians to secure them for hospitals and SNFs that cannot secure generators from the private sector. Remember, the government agencies who maintain these temporary generators do not have the cabling or qualified personnel to install these generators at a healthcare facility. Facilities should consider investing in cabling and quick-connect devices and contracting with a service provider qualified to install temporary generators before an emergency situation.

Power Safety Tip – Ensure that emergency power system is not feeding power back into the grid prior to utility restoration.

There have been documented instances when temporary generators have been connected to a facility's electrical system in a way that bypasses the Automatic Transfer Switch (ATS), increasing the danger of emergency generators feeding power back into the grid and endangering utility workers. Prior to the utility power restoration, make sure there is no power source that is not connected through the ATS. Also, make sure that the ATS units are functioning properly before utility power is restored.

Appendix N - FEMA D-1 Checklist for Emergency Power Planning Prior to a Power Outage

1. Combustion Air Intake and Exhaust Systems

- ☐ Exhaust piping has no foreign object blockage, i.e., bird and rodent nesting, condensation drained
- ☐ Louvers operational with no restricted movement and no obstructions
- ☐ Rain cap has no restricted movement

2. Batteries

- ☐ Batteries installed in conditioned air space to avoid temperature extremes
- ☐ Cable connections corrosion free and tight on both ends
- ☐ Charging system operational and alarms tested
- ☐ Interconnecting cables sized to compensate for voltage drop
- ☐ Specific gravity and voltages checked and acceptable

3. Generator set controller

- ☐ All lock-out faults investigated, corrected, and cleared
- ☐ AUTO start engaged

4. Output circuit breakers

- ☐ Closed or ready and able to close if electrically operated

5. Load cables

- ☐ Clean and terminations checked for proper spacing and torque

6. Engine block, generator space heaters, circulating pump(s)

- ☐ Operational and circulating warm coolant and oil (if equipped with pump)

7. Fuel Delivery System

- ☐ Fuel quality tested and storage vessels maintained to prevent water accumulation and bacterial growth
- ☐ Fuel transfer pumps powered by the emergency system and periodically tested
- ☐ Preferred customer agreements in place with fuel suppliers to assure delivery
- ☐ Storage vessels, including day tanks, topped to appropriate levels

8. Engine oil

- ☐ Leaks inspected and corrected
- ☐ Level proper
- ☐ Low run time, capable of at least 48 hours continuous run time
- ☐ Scheduled oil sample results reviewed and proper actions taken
- ☐ Spare oil and delivery methods, i.e. funnels, pumps, drum carts, etc. nearby

9. Consumables – 10-day supply (minimum) in on-site storage

- ☐ Air filters
- ☐ Coolant
- ☐ Fuel filters
- ☐ Oil
- ☐ Oil filters

10. Local, state, and federal authorities and service organizations

- ☐ Aware and in agreement that fuel delivery and engine generator set parts and service organizations are to be considered and labeled as emergency vehicles with authorized site passage
- ☐ Emergency plans implemented
- ☐ Road maintenance crews aware and in agreement that site's public access is critical and shall be maintained at all times to allow emergency vehicle passage

11. Communications

- ☐ Portable cell towers available and capable of being placed and made operational in a short time
- ☐ Site data reception and transmission systems inspected and proper operation tested with remote facilities and personnel
- ☐ Site two-way radios and cell phones charged and fully operational

12. Generator

- ☐ Air intake and exhaust air parts cleaned of dirt, debris, and obstructions
- ☐ Bearings properly greased
- ☐ Space heaters operational
- ☐ Windings clean

13. Cooling System

- ☐ Leaks inspected and corrected as needed
- ☐ Proper Levels

Appendix O - FEMA D-2 Checklist for Emergency Power Planning During a Power Outage

1. Combustion Air Intake and Exhaust Systems

- ☐ Louvers operational with no restricted movement and no obstructions

2. Output Circuit Breakers

- ☐ Closed or ready and able to close if electricity operated

3. Fuel Delivery System

- ☐ Fuel quality tested and storage vessels maintained to prevent water accumulation and bacterial growth
- ☐ Fuel transfer pumps powered by the emergency system and periodically tested
- ☐ Storage vessels, including day tanks, topped to appropriate levels
- ☐ Water separators drained

4. Engine Oil

- ☐ Level checked periodically and determined proper

5. Consumables – Restock to a 10-day supply (minimum) in on-site storage

- ☐ Air filters
- ☐ Coolant
- ☐ Fuel filters
- ☐ Oil
- ☐ Oil filters

6. Local, state, and federal authorities and service organizations

- ☐ Emergency plans implemented
- ☐ Fuel delivery and engine generator set parts and service organizations allowed site access
- ☐ Road maintenance crews maintaining site's public access
- ☐ Service organizations implementing emergency plans to assure effective support staffing is available and capable

7. Communications

- ☐ Portable cell towers available and capable of being placed and made operational in short time
- ☐ Site data reception and transmission systems properly operating
- ☐ Site two-way radios and cell phones charged and fully operational

8. Generator

- ☐ Air intake and exhaust air paths cleared of debris and obstructions
- ☐ Bearings properly greased
- ☐ Ensure safe and easy access to Generators, Switchgear, Transfer Switches & Fuel Systems. Make sure that all debris is cleared from around your emergency power generators. Also, move or remove vehicles, trash compactors, containers, and other items that may block access to personnel and service trucks, including fuel providers.
- ☐ Stable output voltage and frequency
- ☐ Winding temperatures acceptable
- ☐ Beyond fuel system problems, cooling system failures are the second most common source of failure during extended run times. Be sure that the coolant is topped off to the proper level and that all hoses are free of leaks. Ensure that the radiators are free of debris and that the radiator fan is working properly.
- ☐ Make sure that generators, switchgear, transfer switches, and pumps are all in the On and/or Auto setting

9. Condition Monitoring

- ☐ Receiving data
- ☐ Results normal

Appendix P - FEMA D-3 Checklist for Emergency Power Planning Following a Power Outage

1. Combustion Air Intake and Exhaust Systems

- ☐ Exhaust piping inspected and drain condensation
- ☐ Inspect for wet stacking and develop a corrective action plan
- ☐ Louvers closed and no obstructions
- ☐ Rain cap closed

2. Batteries

- ☐ Cable connections corrosion free and tight on both ends
- ☐ Charging system operational and alarms tested
- ☐ Specific gravity and voltages checked and acceptable

3. Generator set controller

- ☐ All lock-out faults investigated, corrected, and cleared
- ☐ AUTO start engaged

4. Output circuit breakers

- ☐ Closed or ready and able to close if electrically operated

5. Load cables

- ☐ Cleaned and terminations checked for proper spacing and torque

6. Engine block, generator space heaters, circulating pump(s)

- ☐ Operational and circulating warm coolant and oil (if equipped with pump)

7. Fuel Delivery System

- ☐ Fuel quality tested and storage vessels maintained to prevent water accumulation and bacterial growth
- ☐ Storage vessels, including day tanks, topped to appropriate levels

8. Engine oil

- ☐ Change oil and filter (s) and sample as needed
- ☐ Ensure proper level

9. Consumables – Re-stock 10-day supply (minimum) in on-site storage

- ☐ Air filters
- ☐ Coolant
- ☐ Fuel filters
- ☐ Oil
- ☐ Oil filters

10. Local, state, and federal authorities and service organizations

- ☐ Emergency plans reviewed and improved
- ☐ Road maintenance crews remove debris and repair damage to allow site access
- ☐ Service organizations' emergency plans reviewed and improved

11. Communications

- ☐ Portable cell towers retracted, maintained, and properly stored
- ☐ Site data reception and transmission systems inspected and proper operation tested with remote facilities and personnel
- ☐ Site two-way radios and cell phones charged and fully operational

12. Insulation system test conducted and results analyzed to detect erosion

- ☐ Air gap between rotor pole and stator measured at 12:00, 3:00, 6:00, and 9:00 positions, recorded, and analyzed to detect bearing wear or misalignment
- ☐ Air intake and exhaust air paths cleared of debris and obstructions
- ☐ Excitation system inspected and tested
- ☐ Insulation system test conducted and results analyzed to detect erosion properly operating
- ☐ Space heaters operational
- ☐ Voltage regulator connections inspected and properly torqued

13. Cooling System

- ☐ Drain, flush, and replace coolant as needed
- ☐ Ensure proper levels
- ☐ Inspect and correct leaks

Appendix R – The 10 Most Common Causes of Generator Failure

1. Weak or Dead Battery

While there are many reasons generators fail, battery problems rank among the most frequent culprits. A variety of factors can adversely affect battery performance, including wires that come loose, dirty, or rusted connections, excessive age, or buildup of lead sulfates that accumulate on battery plates and impact the ability to provide sufficient electrical current. Usually, by the time this occurs, the battery will require replacement. Because batteries are so vulnerable to failure, it is critical to check them thoroughly during monthly, quarterly, and annual inspections. While a standard generator battery should last several years before needing to be replaced, routine maintenance can help extend that lifespan.

2. Leaks

Oil, fuel, or coolant leaks are another common source of generator failure — and particularly deceptive because they tend to occur slowly over a period of time. As a result, you may not recognize there's a problem until it's too late. Oil leaks are sometimes a result of wet stacking, a condition in which oil, fuel and other liquids build up in a generator's exhaust pipes. Depending on the severity of the leak, you can potentially lose enough oil to damage your engine. When there is a fuel leak, it not only negatively impacts generator performance but can pose extreme danger, potentially leading to malfunctions and fires that can damage property and injure personnel. To prevent fuel leaks, make sure that the pump systems, fuel lines and storage tanks are inspected on a regular basis and promptly repaired. Finally, because coolant leaks usually occur in the hoses of the block heater, it is important to use only silicone hoses that are specifically designed to withstand extreme heat. Properly maintaining the cooling system and replacing hoses every few years will reduce the risk of failure. Additionally, since coolant can deteriorate over time, the system should be flushed and replaced per the manufacturer's guidelines.

3. Insufficient Coolant

Another top reason for generator failure is inadequate coolant levels, which can result in sudden failure and cause damage from overheating. Because of this, it is important to check coolant levels frequently; if you are losing any, there may be a leak in the system. Also be aware of any visible puddles around your diesel generator. If you note either of these conditions, a qualified technician should inspect the unit right away.

4. Poor Maintenance

Operators who neglect maintenance tend to experience a much higher rate of generators failing. For instance, because dirt builds up in filters over time — impacting air quality and making the generator system work harder — filters should be replaced annually. At a minimum, your generator should receive a quarterly inspection, as well as an annual major generator maintenance service call, which includes an oil change, filter replacement, checking of connections, and a run test.

5. Bad Fuel Mix

Lack of fuel maintenance is another key factor in standby generator failure. Without proper service, microbes, debris, additives, and oxygen can build up in the system, diminishing fuel quality. Never use biofuel in any standby generator, as it breaks down over time. To protect your generator, make sure that storage tanks and fuel quality are regularly inspected, and fuel samples are taken at least annually by your service technician.

6. Water Damage

When it comes to problems with emergency generators, water can also be a chief offender. If water accumulates on the outside of a unit, it can cause rust to form, which can lead to corroded wires and impede electrical connections. Similarly, if water reaches the inside of the engine, it can corrode parts and promote bacteria growth, which can clog filters and cause engine damage. This same type of damage can also occur in partially filled tanks, which attract water through condensation.

7. Air in Fuel System

If your generator fails to start, another reason might be air in the fuel system. This tends to develop when the system isn't used on a regular basis, as is the case with most emergency generators. Air can block fuel from getting to the fuel injector, which then prevents the engine from starting. This issue can be avoided by turning on the generator once a week for at least five minutes, which enables air to clear from the fuel system.

8. Control Setting Errors

Human error is another top reason that a generator may fail to start. Most standby generators rely on an automatic transfer switch (ATS) that enables the system to turn on during a power failure. However, this setting is often turned off during routine maintenance or testing. If you set the auto mode to "off," be sure to turn it back to auto when service is complete; if the proper resetting procedure is not followed, a control error could also occur after a fault shutdown. Ensure optimal efficiency and safe operation by regularly reviewing your generator's control setting parameters.

9. Electrical Faults

Another common source of problems in standby generators can be attributed to fault currents. These high current flows within an electrical system can cause a generator's winding to heat up and become damaged. If such a fault occurs in your system, it is critical to have the unit checked immediately by a service technician.

10. Intake and Exhaust Valve Debris

Issues originating within intake and exhaust valves can also negatively impact a generator's engine. Debris can impair key engine components, potentially leading to expensive repairs. To avoid this, be sure to perform valve adjustments based on manufacturer guidelines, as well as at regular intervals afterward. Valves that are not correctly adjusted can become damaged.

Information provided by Unified Power, one of the largest critical power service providers in the U.S.

Appendix S – Generator Fuel Consumption Rate Chart

This chart approximates the fuel consumption of a diesel generator based on the size of the generator and the load at which the generator is operating at. Please note that this table is intended to be used as an estimate of how much fuel a generator uses during operation and is not an exact representation due to various factors that can increase or decrease the amount of fuel consumed.

Generator Size (kW)	¼ Load (gal/hr)	½ Load (gal/hr)	¾ Load (gal/hr)	Full Load (gal/hr)
20	0.6	0.9	1.3	1.6
30	1.3	1.8	2.4	2.9
40	1.6	2.3	3.2	4
60	1.8	2.9	3.8	4.8
75	2.4	3.4	4.6	6.1
100	2.6	4.1	5.8	7.4
125	3.1	5	7.1	9.1
135	3.3	5.4	7.6	9.8
150	3.6	5.9	8.4	10.9
175	4.1	6.8	9.7	12.7
200	4.7	7.7	11	14.4
230	5.3	8.8	12.5	16.6
250	5.7	9.5	13.6	18
300	6.8	11.3	16.1	21.5
350	7.9	13.1	18.7	25.1
400	8.9	14.9	21.3	28.6
500	11	18.5	26.4	35.7
600	13.2	22	31.5	42.8
750	16.3	27.4	39.3	53.4
1000	21.6	36.4	52.1	71.1
1250	26.9	45.3	65	88.8
1500	32.2	54.3	77.8	108.5
1750	37.5	63.2	90.7	124.2
2000	42.8	72.2	103.5	141.9
2550	48.1	81.1	116.4	159.6

Information developed by Generator Source, a multi-state generator sales, service, and rental provider.