

# Protecting your power: Specifying outdoor generator enclosures

## > White Paper

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As businesses and industries add more and larger emergency standby generators to reduce the impact of power outages, the question of where to locate these generators often becomes a problem. Stand-alone buildings or large mechanical rooms are not an option in many applications, particularly existing facilities or other sites with limited space or other installation obstacles. Outdoor generator enclosures are the answer in these situations, and as emergency standby generators have become more vital to the continuation of business, so too have outdoor generator set enclosures that are properly designed, ventilated, secured and located.



Sound-attenuated enclosure systems for Tier 3–certified generator sets (100 to 150 kW) are designed for all-weather outdoor use wherever local ordinances or circumstances require sound abatement.

Once you've decided to install your generator set outside in an enclosure, the overall cost and ease of installation will depend on the physical location of all elements of the system: generator set, fuel tanks and accessories. Several types of enclosures are available, including weather-protective, sound-attenuating and walk-in.

- **Weather-protective.** While all metal enclosures provide weather protection, these basic enclosures only secure the generator set and provide protection from the elements. They do not retain heat or hold temperatures above ambient in cold weather or provide cooling beyond the ventilation and airflow offered by incorporated louvers or perforated panels. Sound attenuation is minimal and, due to their tight fit, access panels or doors are required for maintenance and inspections.
- **Sound-attenuating.** Sound-attenuating enclosures may be specified when noise reduction is needed to meet local ordinances. These enclosures are generally larger and more costly than strictly weather-protective enclosures due to the design features required to reduce generator set noise.
- **Walk-in.** This term encompasses a wide variety of enclosures that are custom-built to a specific application. Walk-in enclosures often include sound attenuation, as well as space for power switching and monitoring equipment, lighting, fuel tanks and other equipment. They can also accommodate insulating and heating capability. Walk-in enclosures may be treated as a building by local inspection officials.

Virtually any size of generator set can be housed in an outdoor enclosure available from the generator supplier or a wide variety of third-party suppliers. If your facility

is considering a new generator that will be housed in an outdoor enclosure, there are several enclosure factors you will want to consider:

### Choosing a site

The location for your outdoor enclosure should be level, well drained and secure from flooding, fire, icing and vandalism. For reasons of reliability, the generator set should be located near the main electrical service but not so close that localized problems at the service entrance will interfere with the generator set. For example, a fire at the utility service entrance would be less likely to affect a standby generator set located some distance away. Control panels and connections should have ample clearance for easy access, and the fuel tank should be located so that refueling is convenient. The National Electrical Code (NEC) requires that all outdoor generators include an inside or outside service disconnect, either at the generator or at the point where the generator feeder enters the building. Also, keep the generator location away from building openings, combustible materials or building ventilation inlets.



This skin-tight generator enclosure at a hospital in Audubon, Iowa, features access panels for ease of maintenance and a residential exhaust silencer for minimizing generator noise.

In multiple-generator applications, be sure there is adequate spacing between generators. Orient the enclosures so that the heat from one generator is not drawn into others.

Sometimes, as a last resort, the only outdoor location for an enclosed generator set may be a rooftop. Provided the roof is properly designed or modified to take the extra weight, this can often be a solution in urban areas.

However, there are advantages and disadvantages. While this location may resolve space limitations, supplying fuel, load bank testing and maintenance may be more difficult.

### All-weather protection

The amount of weather protection needed is often a matter of geography. In tropical climates, the principal weather challenges are sun, heat, rain, salt spray, wind storms, blowing sand and lightning. Within 60 miles of the ocean, aluminum enclosures resist corrosion from salt air. In more northern climates, ice storms, heavy snow and severe cold pose additional threats. It is recommended that any outdoor generator set enclosure have a corrosion-resistant finish (often aluminum or painted steel); stainless steel hinges, corrosion-resistant handles and other hardware; and rain shields on cooling air intakes and exhaust. Cooling air intakes and exhaust may need motorized louvers that open when the generator set is started and close automatically when the generator set is off to protect against precipitation.

The outer surfaces of the enclosure can be primed and painted sheet metal – either steel or aluminum. The paint needs to be of a quality and thickness to retain gloss and to resist minor impacts and corrosion due to salt spray, humidity and water in accordance with appropriate ASTM (American Society for Testing and Materials) standards.

In areas where ice and snow accumulate, it will be necessary to provide for regular removal of snow and ice around doors, louvers and dampers. In cold climates, the enclosure may have to be fitted with an electric space heater in addition to having a coolant heater on the generator engine. For NFPA (National Fire Protection Association) life-safety applications, NFPA 110 requires a minimum ambient temperature of 40 degrees F inside the enclosure. Also, diesel fuel may need to be heated to prevent gelling.

In storm-prone areas, consider an enclosure with added structural strength to withstand high wind loading. Outdoor generator enclosures are available with enhanced strength that resists wind speeds of over 150 miles per hour. In earthquake-prone areas, a seismic-certified enclosure may be required. In flood-prone areas, install the generator and enclosure well above the highest expected water level – on an elevated platform or a rooftop, for example.

## Controlling temperature

Generator sets can maintain their rated power output as long as the ambient air temperature flowing into the enclosure does not exceed the cooling system ambient temperature rating and static restriction. If this air temperature is exceeded, the output of the generator will have to be reduced to prevent overheating of the generator set.

Cooling requirements for the enclosed generator set can also be affected by site selection. Whenever possible, locate the enclosure in an area where there is free air flow. Avoid locations such as covered parking ramps or other nearby walls or overhangs that may restrict cooling air flow or require complex routing of the engine exhaust.

Select an enclosure with adequate flow-through ventilation that keeps temperatures in the optimum operating range. This will allow the generator set to operate at its nameplate rating. The best enclosures incorporate advanced radiator, fan and louver designs that provide optimal airflow through the enclosure to control engine and generator operating temperatures even in the most severe environments. Keep cooling air intakes and exhausts clear of obstacles.

## Security

Vandalism is a common problem that can compromise a standby power system's reliability. Lockable access points to connections, switches and valves deter unauthorized persons from interfering with system operation. Access to the fuel tank and system controls should also be restricted.

## Sound attenuation

Although generator sets used for standby power do not run often, controlling the noise they produce can become a major concern if the units are located near the property line or in a crowded urban environment. Most locales have ordinances that set limits on permissible sound levels at the property line. While exhaust silencers can greatly suppress exhaust noise, much of the noise from an enclosed generator set comes from the cooling air fan. This fan noise is harder to control but can be greatly reduced by careful design of the air intake and air exhaust plenums.

Sound attenuation is dependent on many factors, including the sound level produced by the generator engine, the design of the air intake and air exhaust



A walk-in enclosure at a regional hospital in Swindon, England, houses a new generator installed when the hospital expanded.

plenums, the type of exhaust silencer and local conditions. Work with your generator set and enclosure supplier to determine the level of noise suppression needed to comply with local regulations. Most generator set enclosure providers offer one or more levels of sound attenuation as options.

Additional issues regarding sound attenuation include:

- Critical sound-attenuation remedies will increase the overall footprint, complexity and cost of an installation.
- Sound-attenuating materials in the walls and ceiling of the enclosure trap not only sound but also heat.
- If sound attenuation is required, specify non-hygroscopic and non-flammable material to prevent moisture buildup inside the enclosure.
- Pay particular attention to noise generated at cooling air intake and exhaust plenums. The design of airflow through the enclosure is critical to minimizing this noise.

## Fuel

For increased security and to reduce the footprint of your installation, many generator sets can be ordered with an integrated high-capacity fuel tank. Integrated fuel tanks protect fuel lines and filler connections within the enclosure for better security and provide a very compact installation. Look for tanks that include dual-wall construction, fuel gauges and provisions for catching fuel leaks, ruptures and overflows. Be sure to allow sufficient clearance around the enclosure to allow fuel trucks to access the enclosure. Consult with local authorities regarding fuel tank codes.

### About the author



Jim Iverson is a senior applications engineer for Cummins Power Generation. He develops technical input for published literature and software, publishes technical papers on relevant industry topics, provides application

engineering support to customers and participates in domestic industry codes and standards development. An employee since 1976, he previously managed transfer switch design, systems engineering, switchgear and controls and technical marketing and sales. He holds a master's in engineering science and a bachelor's in electrical engineering.



A semiconductor manufacturing facility in southern Florida relies on painted aluminum enclosures to provide corrosion-resistant weather protection.

### Maintenance

In walk-in enclosures, make sure there is sufficient room within the enclosure for easy maintenance access to key generator set components. Skin-tight enclosures should have large access doors and panels. Good interior and exterior lighting can make all maintenance and troubleshooting tasks easier.

### Conclusions and recommendations

Specifying the best enclosure for a standby power system is an important task, because it can have an impact on both the short-term operation and long-term reliability of the system. Start with a thorough assessment of your power needs, installation location and environment, and work with your generator set and enclosure supplier to design an installation that fits all your specifications.

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