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WHITE PAPER

Location Considerations When Installing Commercial and Industrial Standby Generators

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INTRODUCTION

Improvements in both generator and engine technology such as significantly more efficient and quiet operation, as well as reduced emissions, have increased the number of applications where standby/backup power can be used. A key consideration for any project is determining where the generator will be located.

This evaluation involves many technical factors that go beyond a simple indoor versus outdoor comparison. For example, determining whether an application would be best served by a single, large generator or a paralleled solution with multiple, smaller generators can impact the location decision significantly.

In addition, some contractors and engineers may prefer indoor placements that are shielded from the environment, while others may favor outdoor placements with purpose-designed enclosures for protection from the elements. In most cases, there is no right or wrong answer---it all boils down to determining the optimal location, based on logistics and budget.

This whitepaper will outline the issues to consider when determining where to place a generator or a set of generators. This will allow the specifying engineer to weigh multiple factors and make informed decisions about the optimum placement of standby/backup power systems whether for indoor or outdoor applications.

SPACE VERSUS COST

Indoor real estate can be substantially more expensive than outdoor real estate. When locating a generator indoors, the space to accommodate a single, large standby/backup generator system, along with the required three feet of clearance on all sides of the generator (per National Electric Code [NEC]) needs to be balanced with the building owners' needs for maximizing occupancy and usable space within the facility.

Large generators are also both bulky and heavy, so logistics for transporting and configuring the generator(s) must be considered. For new buildings, the generators can often be placed in the facility early in the construction process minimizing logistical problems.

Retrofits are another story. For example, many urban areas have narrow streets that may make it difficult for trucks to navigate to the location. Streets may need to be closed to allow safe transport and off-loading of the unit.

When considering logistics, rather than specifying a single large generator for a facility, engineers may determine that using multiple, smaller generators are a preferred option. The smaller size and reduced weight of smaller units, may make it easier to accommodate an indoor location.

AIRFLOW

While providing enough area to accommodate the size and required clearance space of the generator is crucial, having adequate space for proper airflow is equally important. The engine powering the generator creates a large amount of heat which must be removed from the area to prevent overheating. High heat taxes the engine which may trigger a shutdown sequence to prevent damage to the engine and generator. Ventilation is typically done through the use of an air inlet, air outlet/exhaust fan, and/or other ventilation openings. The air inlet must be capable of moving

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enough air through the room to provide the correct minimum CFM (cubic feet per minute) cooling for the generator as specified by the generator's manufacturer.

In most cases, the exhaust should be vented above the roof. The exhaust system must keep fumes away from the immediate area of the generator, and from building fresh-air intakes. The engine exhaust piping and muffler must also be tight to prevent dangerous carbon monoxide from accumulating in the building.

A remote cooling solution is also often needed for generators that are located indoors. While remote cooling systems do work well, they add complexity, cost and more potential points of failure. Working with a contractor or manufacturer with experience in implementing remote cooling systems is crucial.

FUEL DELIVERY

While natural gas is becoming a much more appealing option for generators, diesel engines still comprise the majority of applications. In either case, a fuel delivery system needs to be taken into consideration. With natural gas, the natural gas piping needs to be run to the installation site. For diesel, the fuel for the generator will likely be stored outdoors in a large subtank to save pricey indoor real estate space. That tank is typically sized to provide anywhere from three to ten days of mission critical operation during an outage.

The large outdoor subtank is connected to a smaller, indoor day tank. The fuel must be delivered with proper pressure and flow to keep the generator operating properly. The connections and linkage from the subtank to the day tank add complexity and additional potential points of failure to the system.

SOUND AND VIBRATIONS

Indoor generators are shipped without enclosures that are specifically designed to contain sound and vibrations. As a result, vibration isolators are used between the genset skid and the floor foundation to reduce sound and vibration transmission to the building.

SECURITY / ACCESS

Routine access to the generators is needed for maintenance and inspections to ensure that leaks or other dangerous conditions do not develop with age or use. At the same time, access to the area needs to be limited so items are not placed and stored around the generator, the potential for accidents are minimized, and incidents involving an individual with the intent to do harm are prevented.

While placing a generator indoors obviously adds complexity to the system, in some cases, it is the best viable option for the application. The best advice is to have the generator manufacturer involved early in the design process so that the space, airflow, fuel, code and security issues are taken into consideration and the optimum system is designed and implemented.

OUTDOOR INSTALLATION

External placement of standby generators is the preferred choice, when possible. Generators with factory, weather-proofed enclosures are specifically engineered for outdoor performance and the manufacturer has already tested and proven the reliability of the enclosure and unit. In addition, the enclosure is designed to minimize sound and vibration, while maximizing airflow.

At the same time, optimal placement of the generator(s) is equally important with outdoor applications as it is with indoor applications. Facility managers or customers may prefer the generators to be located in an area that is "behind the scenes" to maintain the design aesthetics of the structure. This may not be the best option based on site-specific conditions such as wind and weather patterns, accessibility and code compliance.

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CLEARANCE AND WIND PATTERNS

It is important that the area surrounding the generators be clear of debris such as leaves that could be pulled into the generator during operation. The more contaminants that get drawn into the air vents, the greater the potential for restricted airflow and overheating issues.

While not all debris can be avoided in outdoor applications, it can be greatly reduced by considering prevailing wind patterns and determining where leaves, garbage and other debris normally collect at a site. For example, if the facility has several large buildings located in a campus-type arrangement, there can be a wind tunnel effect that occurs—driving debris, grass or snow to a central location. A fence or decorative shelter may also tend to collect debris. If possible, these are the locations to avoid when determining a placement for the generator.

SEVERE WEATHER PATTERNS

Generators are designed to work during outages which occur due to storms, high winds or other natural events. While it is true that extreme weather can conceivably approach from any direction, for most of the country it tends to follow regular patterns. Knowing this, placing natural or physical barriers such as a hillside or berm between typical weather patterns and the generator can help prevent interruption before the genset is able to respond to the facility's needs.

Looking at a real world example, St. John's Regional Medical center in Joplin, Missouri took a direct hit from an F5 tornado. The generator plant was located directly in the path of the weather system and was the first casualty of the storm. This plunged St. John's Medical Center into total darkness at the very beginning of the crisis. If typical weather patterns would have been taken into consideration when determining the location of the generator plant, the Medical Center might have had a better chance of keeping their vital systems online during that storm. While weather events are unpredictable and can't be avoided, any assumptions/considerations that can be taken into account prior to installation may increase the chance of success.

POTENTIAL FOR FLOODING

When looking at weather patterns, another concern is the potential for flooding. Gulf and Eastern coastal areas are constantly challenged with flooding due to storm surges. One solution is to place generators on platforms to avoid the flooding. However, placing only the generators on platforms does not solve the entire problem. Incoming utility and—most importantly—electrical distribution must also be placed above the flood level, if a platform location is to have any protective effect.

As a result, a raised platform design is typically used with new facilities, not retrofits, due to the complexity and costs involved with moving utility components to ensure electrical distribution to the generators.

Another option to consider is a rooftop application. This can be a desirable solution in lowland areas where flooding could impair the generator's operation as well as urban areas where costly real estate is at a premium.

SERVICEABILITY AND ACCESSIBILITY

Another consideration when locating a generator is year-round accessibility to the location of the unit for servicing. Factors to consider include whether special equipment such as snowmobiles, ATV's or four-wheel-drive trucks will be needed to access the units. Will the access points be impacted—or compromised—during an ice storm, rain storm or other major weather event? How will replenishing of oil, anti-freeze and fuel to these units be accomplished during adverse weather conditions? In some cases, a service road designed for the generator plant may solve these problems.

Another aspect of serviceability is being able to maintain all of the mission critical functions of the facility during routine maintenance. For example, if the facility relies on only a single generator, that generator must be taken out of service during routine maintenance. In most cases, a rental generator is used to ensure mission critical operations will be protected should an outage occur during service. When a rental generator is used, there must be adequate space provided for the generator as well as connectivity points for operation. The reliability of a well-worn rental unit may also be a concern.

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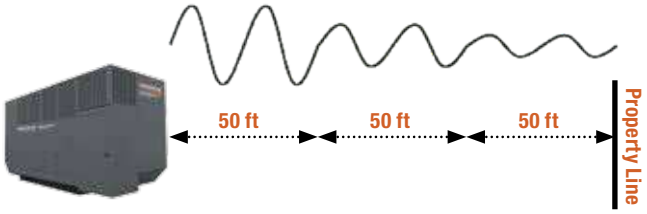
Rental generators are not needed when a facility implements an MPS solution. With multiple generators available, unit(s) can be taken out of service for repair or scheduled maintenance without complete loss of a site's standby power. Remaining in-service units can still serve the critical site loads.

SOUND BARRIERS

Sound requirements are driven by local ordinances and the required dba levels are set at the property lines. Keep in mind that dba levels drop fairly significantly every fifty feet. In other words, dba requirements at the property line are not the dba requirements of the generator. Dependent on placement, added cost for special sound attenuated enclosures may or may not be needed. As a result, placement is an essential consideration with respect to sound levels, enclosure options and overall cost.



LOCATION FLEXIBILITY OPENS UP WITH MPS SYSTEMS

Utilizing multiple smaller generators instead of a single large unit offers greater location and application flexibility for specifying engineers. This can be a significant advantage in meeting many site-specific logistical constraints.

For example, when it comes to rooftop applications, multiple smaller generators offer greater weight distribution than a single larger unit. In addition, the required crane capacity is less. These two factors make rooftop installations much more feasible for smaller, multiple units as opposed to a large single unit.

Smaller generators provide flexibility in applications with height or depth constraints. This often opens up parking garages as other potential locations for the generators.

In addition, generators in an MPS configuration do not need to be located side by side or even together, thus providing significant installation flexibility for retrofit projects.

CODE IMPACT ON LOCATIONS

There are hundreds, if not thousands, of federal, state, local and municipal codes that may impact the location of a generator. This makes it critical to work with local professionals who are aware of the codes and as well as the preferences of AHJs. Local contractors and generator distributors have significant amounts of knowledge about their systems and the optimal design practices for their respective localities. These professionals may be able to save customers time and resources by avoiding potential problems.

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SUMMARY

With standby/backup power generators there is no “one size fits all” solution. This provides specifying engineers, contractors and architects with both choices and challenges for each application. Making a thoughtful, informed generator placement decision can prevent problems and ensure operation of the unit(s) when they are needed.

FOR INDOOR APPLICATIONS, THE KEY FACTORS ARE:

Space: Generators are large and bulky, so cost, logistics and maximizing space for the building occupants must be considered in determining the location of the generators.

Airflow: To prevent overheating, there must be adequate airflow around the generator and the installation must meet NEC requirements. This could entail the use of a remote cooling system, which adds complexity to the design.

Fuel Delivery: Diesel generators remain the most commonly used in commercial/industrial applications. In most cases, a large outdoor fuel subtank is linked to a smaller, indoor day tank. The linkage and collections between the tanks add more potential points of failure to this indoor solution.

Sound/Vibration: The generator engine and possibly the remote cooling systems can be noisy. Vibration isolators and other barriers may be needed to prevent inconvenience to building tenants.

Security/Access: Only authorized personnel should have access to the area where the generator plant is located to ensure generator reliability and safety.

FOR OUTDOOR APPLICATIONS, THE KEY FACTORS ARE:

Clearance and Wind Patterns: Note where snow and other debris typically accumulates at the location and place the generator elsewhere. Also, providing adequate clearance for the generators is key.

Severe Weather Patterns: When possible, place a natural or physical barrier between the prevailing storm direction and the generator. This can help ensure the generator will still operate during extreme weather events.

Potential for Flooding: The Gulf and Eastern Coastal areas have experienced much flooding in recent years, so engineers are requiring generators to be placed on platforms. However, if the incoming utility and electrical distribution are not also set above the flood line, the solution may not work.

Sound Considerations: Local ordinances have sound (dba) requirements that are set at the property line. Generators that are placed an appropriate distance away from property lines, may not need special sound attenuating enclosures.

Security/Access: Be sure that service technicians are able to access the generator during all types of harsh weather conditions, including rain, snow and ice. Also, ensure that only authorized personnel can access the generator to ensure safety and security.

There are pros and cons to both indoor and outdoor generator placements, with many factors that must be taken into account. Federal, state and local codes must also be considered.

Your best resource is your local generator distributor. In many cases, they have already designed/installed a similar application so they can offer advice based on that experience. In addition, they have a wealth of local knowledge that can help you make the best location decision.

Visit generac.com to find your local Generac Industrial Power Network Distributor/Dealer, or contact Generac Power Systems directly at AskGNRC@generac.com or toll free at 1-844-ASK-GNRC.

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