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Packaging Your Power: An Insider's Look At Data Center Backup Generator Enclosures

Kohler Special Report

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When it comes to ensuring reliability and resiliency for your data center, selecting the right generator is just the beginning. An often overlooked—yet vital—aspect of your backup power setup is the generator enclosure. While it might be tempting to focus solely on the generator itself, the enclosure plays a crucial role in overall performance, safety, and service. Each data center has unique environmental and operational needs, and the right enclosure must address these specificities.

This guide explores the key considerations and lesser-known factors surrounding enclosures that can make a significant difference in the longevity and effectiveness of your backup power solution. From size and emissions to weather and security, understanding these elements will help you make a well-informed decision for your data center, taking care of your backup considerations so you can focus on what you know best: providing low latency and robust connectivity.



Packaging 101: Essential Enclosure Elements

Let's talk about an easily forgotten, all-important aspect of backup power: enclosures.

As generators come, most manufacturers and models offer a relatively standard product. As a data center, it can be easy to think that choosing a power node is the main part of your process in finding the right backup power solution. While your choice of genset may be straightforward, an optimal package for it can be the real challenge.

Whereas many aspects of a data center can be standardized, each facility's site environment is ultimately different. Finding the right backup power solution involves identifying the unique aspects that will affect the package around the generator—things like noise levels, temperature requirements, and space restrictions. For many, the building of a generator into this critical housing unit presents a major weak point in the industry and is the true test of how well a vendor can meet the needs of a given data center.

The ability to address these aspects through design of the enclosure can greatly enhance the generator's performance, efficiency, safety, and compliance with environmental regulations. Here are some of the basic, high-level factors that you should consider when evaluating the functionality of a generator enclosure:

Cable Entry

Allowing for effective cable management presents a vital element in the enclosure design process. Effective planning in this area consists of factoring in where cable comes in, but also accommodating what the cable system may look like: allowing for aspects like onboard switchboards, outdoor switchgear equipment, or—in some cases—no switchgear at all.

Emission Control

With stricter environmental regulations, enclosures need to integrate systems for emission control. This includes space and provisions for installing technologies like SCR (Selective Catalytic Reduction) and DPF (Diesel Particulate Filters). Proper ventilation and exhaust systems must be designed to accommodate these technologies without compromising their effectiveness.

Integration with Renewable Systems

For hybrid systems that combine diesel generators with renewable energy sources, enclosures might need to accommodate additional equipment like inverters, batteries, and control systems. The design must ensure all components are housed properly to work together efficiently without overheating or interference.

Maintenance Accessibility

Proper enclosure design must also consider maintenance access. Doors, panels, and other components should be easily accessible for routine checks and repairs without needing to disassemble the entire structure.

Modular and Scalable Designs

As businesses increasingly opt for modular and scalable generator systems, enclosures must be designed to accommodate these configurations. This can mean designing enclosures that can house multiple small generators or allow for easy expansion as power needs grow. Modular enclosures can be pre-fabricated and easily assembled on site, which reduces installation time and costs.

Noise Reduction

Enclosures are essential for noise control, especially in urban or residential areas where noise regulations are strict. Advanced production and design measures can be used to minimize sound emission. For example, sound-attenuating materials and double-walled construction can significantly reduce the noise output from diesel generators.

Security and Vandalism Prevention

Enclosures provide security for the generator against theft and vandalism. Tough construction materials, lockable doors, and security systems are incorporated to prevent unauthorized access. This is particularly important in remote or unattended locations.

Smart Features and Connectivity

Modern generator enclosures often incorporate advanced monitoring systems that require connectivity solutions. Enclosures must have provisions for installing these systems, including mounts for sensors, space for data loggers, and pathways for wiring. Ensuring that these technologies are protected from environmental factors is also crucial.

Weather and Environmental Protection

Enclosures protect generators from environmental elements like rain, snow, wind, and extreme temperatures, which can affect performance and lifespan. Materials used in enclosures are chosen for durability and resistance to corrosion, and climate control inside the enclosure, such as heating and cooling, can be necessary to maintain optimal operating temperatures—particularly when integrating waste heat recovery systems.

COMPONENTS OF DATA CENTER BACKUP POWER ENCLOSURE

Air Intake and Ventilation

- Air Filters
- Ventilation System

Control System

- Automatic Transfer Switch (ATS)
- Control Panel
- Remote Annunciator

Cooling System

- Cooling Fans
- Coolant Lines and Reservoir
- Radiator

Electrical System

- Battery
- Battery Charger
- Circuit Breaker and Fuses
- Paralleling Switchgear

Exhaust System

- Exhaust Pipes
- Muffler

Fire Suppression System

- Automatic Detection System
- Fire Extinguishers

Fuel System

- Fuel Filters
- Fuel Lines
- Fuel Tank

Genset

- Alternator
- Engine

Lighting

- Exterior Lighting
- Interior Lighting

Security and Monitoring

- Sensors and Alarms
- Surveillance Cameras

Size and Shape: Why A Walk-In?

Data center backup power enclosures are typically divided into two categories: walk-in style, and container style (sometimes called skin-tight enclosures). When discussing the backup power generator housing for a data center, the primary differences between the two enclosure types are related to their design, functionality, accessibility, and maintenance features.

WALK-IN ENCLOSURE	CONTAINER ENCLOSURE
Spacious, One-Room Building	Compact, Close-Fitting Structure
Easy Access for Operational Convenience	Limited Access, More Challenging Maintenance
Room for Storing Tools and Parts	Minimal Storage Space
Improved Safety From Controlled Environment	Ideal for Quick Inspections
Higher Initial Cost	Lower Initial Cost
Enhanced Weather Protection	Basic Weather Protection

Where container enclosures are suitable for data centers where space is at a premium and cost savings are highly prioritized, the most common choice for contemporary data centers is the walk-in category. In fact, the rise of walk-in enclosures has come, in large part, because of the proliferation of data centers and their service requirements.

The all-important need for constant uptime means that large data center campuses require many backup gensets, sometimes as many as 40 on a single site. To maintain reliability, these gensets must undergo a rigorous and consistent maintenance program. When a large number of generators is combined with a high frequency of testing exercises, technicians can't afford to have their scheduling put off by rain or snow. Compared to container enclosures where components must be disconnected and removed in order for the engine to be serviced, walk-in enclosures offered open access points in a protected space—requiring no dismantling or detaching. As such, the ability to service and maintain generators from inside an enclosure is highly convenient. Once walk-in enclosures became commonplace for hyperscale-sized facilities, smaller data center campuses followed suit simply because of the ease and flexibility that a larger, more comfortable working environment offers for technicians.

Plenty of additional considerations for a walk-in must be accounted for that don't exist for container enclosure. For instance, a walk-in enclosure must abide by building codes, meaning things like exit signs, crash-bar door hardware, multiple egress points, and additional electrical clearances must be factored in. However, even with these extra considerations, most data centers decide that, over the course of a 20 or 30 year product lifespan, the ease-of-maintenance advantages add up.



An Enclosure Above: What Separates A Good Package From A Great One

We've covered the fundamentals that are often top of mind when selecting an enclosure. However, there are critical but often overlooked factors that can significantly impact the performance, maintenance, and longevity of a backup power investment. Here are some of the more nuanced, yet still-essential insights a data center may need to make an informed decision on a generator enclosure.

Customization Process

Finding the right generator enclosure must involve the search for a vendor that can provide a collaborative and productive customization process. With design modification flexibility being an important factor, your requirements could be met in one of two different ways.

1. Internal engineering resources may set the specifications. In these situations, a data center team often has their own ideas around pre-engineered components and a strong idea of preferred modularization and phasing that you bring to the generator vendor.
2. Your team may not have any particular knowledge around how exactly your generator enclosure should be customized.

In these circumstances, a data center team will work closely with their vendor to develop specifications to meet all site constraints within the enclosure customization process. Regardless of which route works best for you, an effective method of developing and agreeing upon project specifications is crucial for a satisfactory end product.



Exhaust Configuration

Often, a data center's building and site design are completed before backup power is deliberated on, so the enclosure footprint must be responsive to a pre-existing set of constraints. In worst-case scenarios where exhaust flow is not taken properly into account, engines will distribute hot air into a space where the data center's chiller plant draws air, compromising the performance of the facility's entire cooling system. Exhaust systems need to be considered in the context of facility layout, whether that means ensuring that the putting the exhaust location under more advisement in the original site design, or being creative with the size and direction of the exhaust stack after the fact using custom-fabricated exhaust components to optimize specific space requirements.

Rust Deterioration

As with any long-term hardware investment, guarding against degrading materials stands as a vital issue. Nearly all genset enclosures are constructed from extruded aluminum to prevent corrosion, however, external fasteners holding against the weather have the potential to leak over time. A rusty bolt or rivet head creates rust streaks, something that compromises the integrity of an enclosure's panel walls through the years. The ultimate solution for such an issue is to remove external fasteners as a factor altogether. Using adhesive skin as a sealed, overlapping material over enclosure panels eliminates the need for rivets or bolts, and this eliminates the probability of rust corrosion.

The problem of corrosion also applies to noise-reduction equipment. Some enclosure silencers are mounted externally on the structure's roof. As silencers are typically constructed with painted steel, they are at risk of rust, especially since high exhaust temperatures compromise any protection the paint may offer. Internal silencers offer a solution to this issue, as the confines of the enclosure offer an unexposed surface, out of the elements and safe from corrosion risks.

Sources and Workforces: Finding An End-To-End Solution

When sourcing an enclosure, one of the most important questions is: where is the enclosure coming from, and who is making it? For many backup power vendors, the supplier manufactures the genset, but outsources the enclosure to a third party. There are, however, many advantages to working with an engine manufacturer that builds its own enclosures:

Cost Increase

With third party outsourcing, there is an additional layer of cost margin to be factored into the enclosure fitting process. With a factory-direct enclosure, the manufacturer will quote the price of the entire solution, complete with their markup to be profitable. With a third-party enclosure manufacturer, however, doubling the amount of vendors means that markup is happening twice. In this way, the quoted cost to a data center will include another layer of cost margin, something that can add up to tens or even hundreds of thousands of dollars across a multi-genset project.

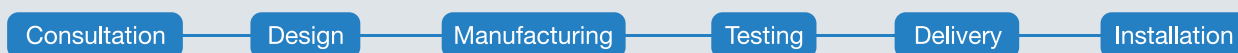
Commitment To Quality

With the inclusion of manufacturing space dedicated to creating generator enclosures and capabilities to include the range and volume necessary, a vendor that builds its own generator enclosures shows a higher commitment to providing the best solution possible. By demonstrating an investment in providing an optimal product, it's a message to you that they take their role seriously.

Logistics Streamlining

Hosting the entire building process under one roof is an advantage because the same people are working on every step of one large process, instead of two separate groups working on two separate processes as with a genset manufacturer and an enclosure manufacturer. Those two processes can involve the extra time and headaches involved with adding more people to the process: there are more designers, applications engineers, sales associates, and project managers to deal with. It means more locations, more scheduling, more transport, and more room for error. Sometimes, a fourth party is introduced, charged with handling the logistics that have emerged with managing the enclosure's assembly, testing, and delivery. On the other hand, a factory-direct setup involves less communication, fewer personalities to loop into in the process, and an avoidance of the telephone game for specs—all resulting in a faster, easier process with less room for miscommunication.

End-To-End Solution



Third Party Solution



Quality Standards

A facility that manufactures enclosures only, will—because these structures are relatively lower-stakes products—have different quality standards than a facility that manufactures something as vital and complex as a diesel engine. For a factory-direct option, the same quality standards that apply to manufacturing and assembling a generator will also apply to the enclosure that houses it. When it comes to auditing for manufacturing standards, the vendor with a more robust and defined process for quality control will be the one producing the best quality enclosure.

Sole Accountable Party

Working with a vendor who can engineer and manufacture your custom enclosure in-house means your backup power solution will be delivered as a complete end-to-end solution. The entire process—assisting with design at the front end all the way through to controlling the fabrication process and supporting the product when in an operational environment in the field— is managed by one party all the way through its lifecycle. It's a one-stop shop for technical considerations, and one hand to shake for finances and logistics.

Testing Simplicity

When a genset is produced separately from its enclosure, it must be shipped to a different location for testing. The testing that occurs here is not merely monitoring the performance of the engine—it involves an intensive inspection of the entire solution, including air flow, power usage, environmental standards, and more. Beyond the fact that the testing will not be performed by the genset manufacturer, there are other questions about liability and responsibility inherent in the more complicated process of testing the solution off-site that are not present if the engine manufacturer performs the all-important final test at the system's point of origin.



Kohler eFRAME Enclosures

At Kohler, we take our cues from data center leaders to design products that suit the needs of a topnotch network hub. With that in mind, Kohler has designed a range of exclusive eFRAME enclosures that are specifically geared to accommodate Kohler generators. The eFRAME enclosure ensures that your complete power generation needs are available from a single source. Trust Kohler to install, service, and maintain your generator system and all its powerful parts.

Flexible

The eFRAME walk-in enclosure is ideal for mission-critical applications. Our enclosures accommodate a variety of uses through the optimization of additional features, such as the capability to modify switchboard and breakers to meet customer requirements with additional state and local code options available for the subbase tank.

Reliable

Each eFRAME goes through rigorous testing and approval to ensure reliability. Receiving the UL 2200 FTTP certification for construction, this modular frame has been designed to withstand winds of over 135 miles per hour. Additionally, the enclosure is IBC-certified for site-specific use, and its subbase tank meets UL 142, ULC, and all state-specific requirements. Computational fluid dynamic (CFD) tools review the enclosure airflow to ensure generators will operate efficiently in the most demanding environments. Our internal engineering analyses (including FEA) are used to optimize cost while ensuring we meet shipping and wind load requirements.

Accessible

Our custom-designed modular enclosures allow for ultimate serviceability and ease of access to the engine and radiator without the need to disconnect, promoting rapid troubleshooting while ensuring continuous power.

Modular

Reduce service costs and downtime with the modular design of our enclosures, which are capable of being split into three independent sections, making the replacement or service for any generator component quick and easy.

Easy Installation

- Set—Set the tank, mount the generator, and then set the enclosure
- Wire—Wire alternator load leads to the freestanding breaker
- Connect—Customer connections (including load leads), shore power, and communication cables

The Kohler eFRAME walk-in enclosure is a fully-integrated package with all components single-sourced from the Kohler factory. This modular design ensures easy serviceability and can be customized to data center needs. By managing the entire design, production, and testing process in-house, KOHLER enhances quality, reduces lead times, and minimizes service costs and downtime. [Click here for more information.](#)

