Power Generation

Our energy working for you.™

Power topic #6016 | Technical information from Cummins Power Generation

Are All Generator Sets Integrated Equally?

■ White Paper

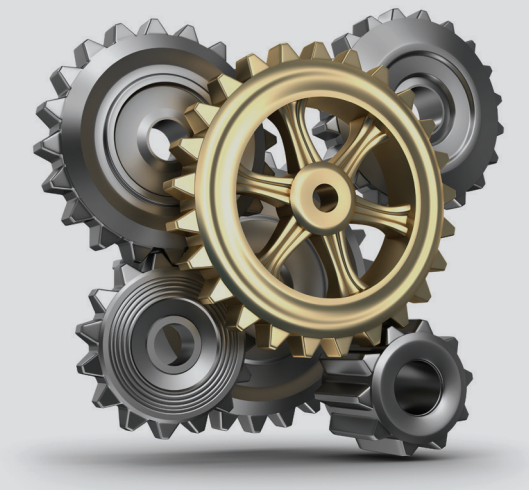
Sanjay Wele, Regional Manager, West Asia, Cummins Power Generation

Diesel generator sets have always been the primary solution for standby, critical and continuous power requirements. Suppliers for the generator set market include a mix of original design manufacturers (ODM) and local equipment assemblers (LEA), offering products of varying quality and prices.

The generator set market is led by ODMs, who typically manufacture all the key components (e.g. engine, alternator, skid base, controls, etc.) that are integrated into a fully validated design and comprehensively tested, resulting in a complete generator set with full warranty. ODMs may also sell some of these components to LEAs, who are at the next level of the supply chain and involved in the component-sourcing and assembly phase of the different generator set components to form a complete generator set.

With these different options in the market, is it sufficient to simply purchase any generator set as long as it can provide backup power, or are there other factors to consider? Are there differences between the two types of suppliers in terms of reliability, backup and cost? What drives this cost differential, and why?

The assembly stage follows a similar model in the 1990s when suppliers for the Personal Computer (PC) industry fell generally into two categories: PC manufacturers and no-name local assemblers who built low-cost PCs around standard components such as Intel's CPUs and other essential hardware. These local assemblers were often a one-man show and were usually unable to provide a prompt response to customers' problems. This lack of aftersales support resulted in the erosion of customer confidence, which hampered their competitive growth in the industry.



Similarly, while it may be tempting to purchase a cheaper generator set typically assembled by a LEA, it is important to consider both the quality of the product in terms of testing and validation, compliance to regulatory standards, as well as the supplier's capability to offer support with regard to servicing, parts and engineering. These areas are important and will have a considerable impact on a generator set's long term performance.

The Complexities of Integrating a Generator Set

A generator set is a complex machine with many stationary and moving parts - ranging from the engine, alternator and cooling systems, to the nuts and bolts used in assembly - all integrated into a complete functioning product. Most purchasing decisions are made based on the engine used in the generator set since it is the power source and prime mover. However, the engine alone does not necessarily guarantee reliable power from the generator set. Other critical sub- components like the alternator, radiator, controls and exhaust systems play equally vital roles to ensure the reliable on-going operation and durability of the generator set.

Returning to the PC analogy, many of us often choose a PC based on the Intel chip, which acts as the brain of the computer. However, we need to recognize that its integration and interaction with other components, such as the motherboard, is even more critical to ensure optimum operation and reliable performance.

The key to a reliable backup power source goes beyond having good quality components such as the engine or alternator; it stems from a seamlessly integrated, carefully engineered and validated generator set that performs reliably and optimally every time. To successfully integrate the multitude of components into a complete and reliable generator set, the supplier must possess extensive experience, capability and in-depth understanding of how these components operate together to offer fail-safe performance.

Conversely, LEAs generally thrive on their ability to source low-cost components from a variety of manufacturers - components that may lack complete product testing and validation, and may not provide optimum performance.

Given the two different integration models, which type of product is more likely to offer better long term performance and durability?

In part, the answer lies in the technical integration, testing and validation of the generator set, together with aftersales service capabilities.

The Whole is Greater than the Sum of its Parts

An integrated generator set supplied by an ODM has several unique performance features that stem from meticulous engineering design and validation of the individual components. Some of the unique benefits derived from such validated integration include:

Component(s)	Benefit(s)
Integration of engine with controls	- Minimize black smoke during starting and transient loading - Monitor battery condition for servicing before experiencing a failure to start - Optimized fuel consumption to save fuel cost
Integration of controls with alternator	- Pulse width modulation (PWM) to minimize distorted waveforms - Self-protecting mechanisms for the alternator and generator set
Integration of controls and the total package (AVR, engine, alternator)	- Better transient response - Digital synchronization in the event of instability on the bus or abnormal frequency conditions - Breaker failure protection to provide warnings or shutdown sequence to prevent generator damage

Innovative design alone is not enough. A program to conduct comprehensive product validation, prototyping and extensive field testing to verify the products' durability and capability, together with total component integration, is required to achieve optimum results. In addition, the product should be subjected to detailed failure mode effect analysis (FMEA) to achieve optimum product reliability.

On average, each generator set design supplied by an ODM will have undergone between 25,000 and 30,000 hours of factory and field testing in real environments to ensure optimum performance and durability. During development, prototype generator sets will be put to the test in factory on-site production test cells where real-world conditions can be simulated for a variety of applications. The prototype will then be tested in multiple configurations to evaluate

the performance of the engine, alternator and other critical components. Additional testing includes paralleling (generator-to-generator and generator-to-utility), linear and torsional vibration, thermal growth, strain analysis and acoustical testing. In addition, the product needs to pass stringent engineering design analysis and component inspection before the design is approved as a final product for sale.

In contrast, LEAs may be able to deliver the products within a shorter period of time. They often begin by sourcing and negotiating the prices for the individual components from various suppliers, to be packaged into a generator set. Typically, due to their small-scale operation, LEAs may not be able to perform the complete and comprehensive total product testing and inspection for each and every product design or component aggregation that leaves their premises. As a result, while the generator set may operate acceptably upon installation, maintenance and operational issues may arise when the generator set is required to run in real world situations.

Testing and quality assurance leads to product reliability. PC manufacturers such as Lenovo and HP are still in business because they are able to provide reliable and complete PCs, which is only possible through extensive testing.

Investing for the Long Term

LEAs, with their sourcing expertise, generally have the capability to assemble the generator sets for a lower cost and often pass this saving to their customers. As the adage goes, "you get what you pay for", customers need to understand why the initial capital cost is low. The following provides an overview of some key areas that customers need to be aware of:

- **Research & Development (R&D)**

  The generator set from LEAs is a product derived from the assembly of various components from different suppliers. There is little to no investment in R&D of components or the total integration as they do not design or manufacture the generator set. R&D is necessary to develop and implement new technology to produce new and improved products to better meet project requirements. Apart from inventing new products, R&D on the integration of the product's components is equally important in order to achieve optimum generator set performance.

- **Aftermarket Parts and Service Support**

  As LEAs are not manufacturers, they generally do not keep stock of the different parts of each component, especially given the varying components from different suppliers utilized in the assembly of the generator set. Customers often need to get the necessary parts required from the original manufacturer or suppliers, if available. In addition, when a generator set breaks down, who should the customer call? Can LEAs offer support even if the generator set fails outside of the warranty period?

- **Maintenance**

  This is another major expenditure during the product's life cycle that can be expensive. Therefore, generator sets that require minimum maintenance and offer longer service intervals are strongly recommended.

- **Product Quality and Performance**

  Benefits such as 100% single step full load acceptance, integral generator set protection and efficient fuel consumption are typically derived from quality parts and complete integration within the system, and not from the assembly of components. Can LEAs guarantee the operational performance of the complete product if they have not done the engineering design and validation? In other words, can they be sure that their assembled product will work as well as they have claimed during its lifespan?

  Suppliers with an extensive track record often encourage customers to consider total operating costs instead of just short term costs. This is particularly important for prime power or continuous power applications where greater product durability, longer service intervals and specific power consumption will lower the overall cost of ownership.

Delivering Absolute Peace of Mind

A generator set is a large investment in capacity and capability to provide on-going support in prime power, standby power and critical emergency applications such as hospitals, data centers and water treatment plants. Warranty and aftersales support are

important factors to consider during purchase as it is essential to know who will provide the aftersales service support and accountability if a generator set fails.

Typically, the warranty coverage offered by LEAs covers individual components, with each component being covered by the individual suppliers. Warranty clauses from different suppliers will also differ and diagnosing the system's faults becomes complicated with each party trying to identify which component failed and the primary cause of failure.

Customers and end-users reviewing their generator set warranty policy are advised to check if the entire generator set's warranty will be covered by the LEA. If it is not, they should identify the contact for immediate support to resolve issues associated with generator set components from multiple vendors.

For an ODM, the complete warranty support is straightforward with typically two years provided for a standby generator set application, including all components. ODMs can guarantee this because each generator set has undergone complete design validation, stringent testing and quality inspection to ensure each component is seamlessly integrated for fail-safe performance. In addition, when customers need immediate service and warranty support, an ODM has the capability and resources to repair or replace components without having to defer to another supplier.

Apart from product warranty, getting round-the-clock, reliable and responsive aftersales support is equally important, especially in critical applications such as hospitals, data centers and air traffic control centers. In addition, the aftersales support for equipment operating in remote locations is equally vital. An ODM is typically able to provide a local, regional and global network of parts, service and technical support to give the customer peace of mind. The complete installation and support in terms of application design, product commissioning and troubleshooting are critical functions which prevent system design failures and ensure the correct application of equipment.

The nature of LEAs' localized business set-ups usually mean their support team will be a smaller group of technical personnel with varied skill-sets to attend to specific product ranges. The leaner resources also mean the LEAs have constraints in geographic coverage and providing round-the-clock aftersales support. A small, specialized team also poses another set of challenges for LEAs in the form of talent and knowledge retention, which is an important part of business continuity and customer retention. Because of their smaller and specialized team structure, a departing technical specialist may leave a gaping hole in the team's capabilities - albeit temporarily - which could impact an on-going customer project. The incoming replacement may also not be familiar with earlier or existing product variations, which will result in challenges providing comprehensive product support and coverage.

Alone You Can Do Only So Little, As a System You Get So Much More

Generator sets are often not run in isolation. Depending on load requirements, the end-user must decide how many generator sets need to run simultaneously and in parallel. Depending on the criticality of the application, generator sets may be required to transfer power back to the utility without any interruption in power supply. To avoid generator sets from tripping, it is important to monitor the load requirements to control the total number of generator sets operating and the load feeder breakers depending on generator set availability. In other cases, to optimize fuel consumption, the generator set needs to run at the point of maximum efficiency with the minimum number of generator sets required.

Seamless coordination between the system components and controls is required for the generator sets, transfer switches, utility incoming and load feeder breakers to operate optimally. With today's technological advancements, the end-user is able to remotely monitor the entire power system - via a mobile phone, the user can receive an SMS with alarms or notifications before the generator set trips, with the ability to identify the real cause of the blackout (e.g. from the engine or alternator). This allows the end-user to respond quickly to identify the location of fault.

An integrated control platform capable of integrating engine, alternator control and protective functionality into a common system is required to enhance reliability. Products designed from the ground up as a single system provide the highest degree of design and performance control to ensure each element works in harmony. A single platform using a single software tool to monitor the entire generator set greatly

reduces the complexity in fault diagnosis and parameterisation. A product assembled with components from various suppliers generally restricts the possibility of integrating this information with power system control using a common platform.

Invest In Your Business' Resilience

Not all generator sets are integrated equally. The purchasing criteria for choosing a generator set should therefore not be based on price alone. This white paper has provided many other factors which need to be considered, including the reliability of the components' integration, aftersales service support, as well as commercial viability. Peace of mind for your business as a result of addressing all the necessary factors is priceless

About the author

Sanjay Wele graduated from the University of Nagpur University with a degree in Engineering in 1996. He has an MBA in Marketing and Operations from SP Jain, Singapore.

Sanjay has almost 16 years of experience in Power Generation and Power Distribution sector, having previously worked with organizations such as Siemens and APIL.

Within Cummins he has held the positions of Global Strategic Marketing Manager and Power Electronics Regional Sales Manager. He is currently the Regional Manager, West Asia for the Cummins Power Generation Sales and Marketing team.

Cummins Power Generation
3850 Victoria Street North
Shoreview, MN 55126
USA

Phone 763 574 5000
USA toll-free 877 769 7669
Fax 763 574 5298

Our energy working for you.™
power.cummins.com

GLPT-6016-EN (10/14)