

Generator Sets for Data Centers. Criteria for selecting, designing and installing units.



The Data Center Continuous Power (DCC) application has experienced growing demand in the diesel generator set industry. It is designed as an alternative source of electric energy for generators in Data Centers and it has specific characteristics that allow it to respond to the need for reliability and availability inherent in Data Center facilities. However, how does this application differ from stand-by or emergency sets that already exist? What is the Uptime Institute and what influence does it have when it comes to choosing the best generator set? How can we be sure which is the most suitable model for our Data Center project?

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A sector in constant growth

The relentless development of activity on the Internet and that of the entire industry associated with this technology is giving rise to an ever greater flow of information over the web and the imperative need to store, handle and analyse a vast amount of data in what we now refer to as Big Data. As a result, the energy generation industry has had to adapt itself to this new way of working and to serving the new data storage needs of such different industries as banking, trade, entertainment or even public administration agencies. Data Centers that make it possible for companies and users to access data quickly, consume a considerable amount of electricity, not only for their normal operating purposes but also for cooling the rooms in which they are housed. The temperature in such facilities has to be kept at around 20°C, which is the ideal working temperature for servers. Any power failure, even one lasting only a few minutes, may well interrupt the work of the entire company and cause important economic losses. Therefore, not only does the electricity that feeds such facilities have to be stable, but

its continuous availability has to be guaranteed by redundant supply sources. This is exactly where electric generators that are specifically designed for Data Centers come into play. Various factors will determine our choice among the generators that are currently available in the market:

- The reliability of the primary electricity grid.
- The budget available for the installation.
- The sensitivity of the data stored in the Data Center, which will determine whether a greater or lesser degree of protection is required against possible power failures.

The Uptime Institute specifies and certifies the design of Data Center facilities

The reliability and the availability of a Data Center are key attributes when it comes to providing one's client with a good, uninterrupted service, particularly when sensitive data is involved. Both aspects depend to a great extent

on the supply of electricity and it is therefore important that we choose a power supply system in line with the importance of the data that is being handled, not to mention equipment that is of high quality and proven efficiency. The **Uptime Institute** is the internationally recognised body that specifies and certifies how Data Center facilities should be designed. It classifies them in four different levels, according to their availability: Tier I, II, III and IV. The precise factor that determines whether a facility is in one level or another is the number of continuous supply sources and the number of emergency supply sources that are available. To answer the question of how the Uptime Institute classification affects the sizing of the generator sets that are going to be installed, it is important that we understand how this body differentiates between an emergency supply source and an **alternative supply source**. The former meets the requirements that the Institution classifies as Tier I and Tier II. The latter is the one needed for Data Centers that require Tier III and Tier IV availability levels.

TIER REQUIREMENTS SUMMARY

	Tier I	Tier II	Tier III	Tier IV
Active Capacity Components to Support the IT Load	N	N+1	N+1	N After any Failure
Distribution Paths	1	1	1 Active and 1 Alternate	2 Simultaneously Active
Concurrently Maintainable	No	No	Yes	Yes
Fault Tolerance	No	No	No	Yes
Compartmentalization	No	No	No	Yes
Continuous Cooling	No	No	No	Yes
Availability	99.671%	99.741%	99.982%	99.995%

Source: **Uptime Institute**

For an energy supply source to be considered **alternative** and for it to therefore meet the Tier III and IV requirements of the Uptime Institute, it must be able to supply electricity continuously in the event of a power failure in the primary source. This means that a generator set must be of sufficient size to be able to supply continuous power at the required load level without any time limitation. If we consider ISO standard 8528-1:2005, this form of operation would be catalogued as COP (Continuous Operation Power).

Why not size the sets in accordance with their declared COP?

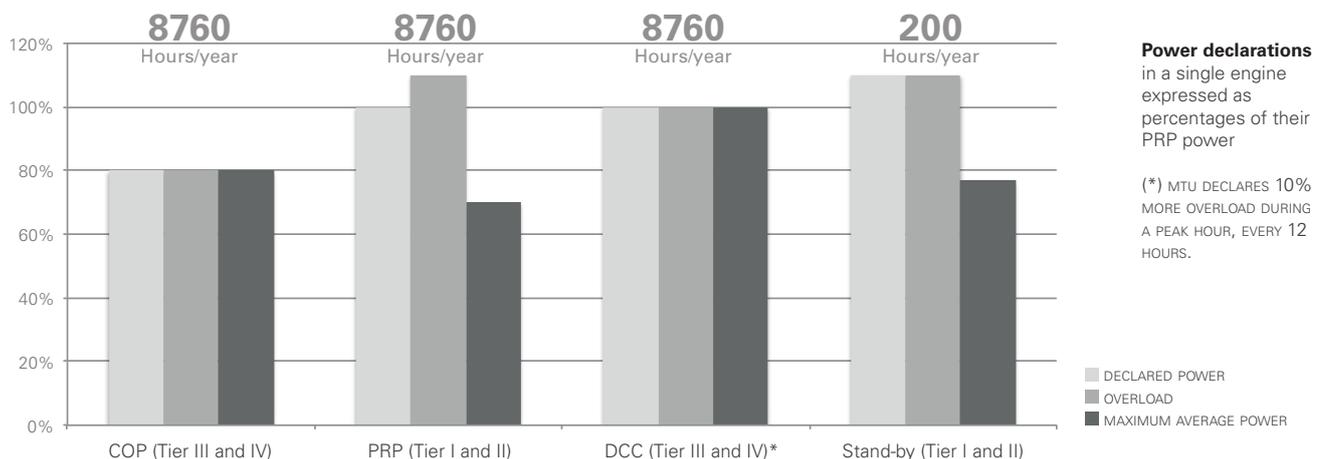
Given that we already have a declaration of continuous power operation, why not use it? The power declared for the COP of an engine is around 80-90% of the nominal or prime power. Sizing generator sets in line with their COP implies having to choose larger engines with the corresponding increase in the cost of the engines themselves and in the costs that derive from their needing more installation space and more cooling. Not only that, the engine would not be working at its most efficient load point,

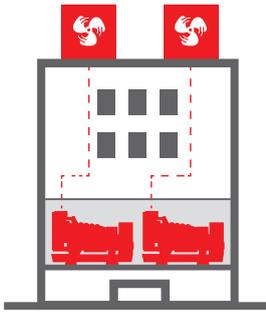
which is around 100% of its power. That is why, in order to be more competitive in the market and to save the end client unnecessary costs, the leading manufacturers of diesel engines for power generation have added a new power declaration, the **Data Center Continuous (DCC)**. In the majority of cases this coincides with its PRP declaration as per ISO 8528-1:2005, in other words, 100% power, but with one difference: in this case it is supplied continuously. After a statistical study of the probabilities of failure and taking into account the experience in existing facilities, these same manufacturers have determined that, in countries with a stable grid, the frequency with which emergency gensets enter into operation is minimal and when this occurs it is for a very short time period. For this reason they are able to allow a high load percentage on their engines during operation.

How does this new DCC power declaration tally with the requirements of the Uptime Institute?

Although the PRP power cannot be maintained indefinitely in an engine (due

to the mechanical and thermal load it has to support), engine manufacturers that use this new DCC declaration guarantee their use without any time limit and without any mean load percentages. Therefore, generator sets that are sized in accordance with this new power declaration will comply with the Uptime Institute's Tier III and Tier IV classifications, given that they comply with the conditions laid down for an alternative power source. As mentioned, this has to do with the low probability of the primary source failing, which is why engine manufacturers limit their use to countries with a stable grid, even going so far, in certain cases, as to list the countries which possess, in their opinion, a reliable grid. Needless to say, if the primary grid is sufficiently reliable, if the data that the center handles is not all that delicate and if having the data available at all times is not crucial, then the facility's availability percentage may be reduced and one may resort to the Uptime Institute's Tier I and Tier II. This makes it possible to select sets that are going to be used as a reserve, according to their stand-by power, thus reducing the installation costs.





**Data Center
Alibaba Group.**
HIMOINSA supplies 24MW of stand-by power. A remote cooling system has been developed locating vertical radiators on the roof of the building.



Key aspects of a generator set that supplies power to a Data Center

The attributes of a generator set for a Data Center application and of its component parts, will by large coincide with those of an emergency set for any other facility, although the choice of some of those components may perhaps be more critical in DCC sets.

Of all the elements, the most important is the **engine**, as this is where the power generated by a generator set comes from. The engine for a DCC application must have an **electronic speed regulator** so that it can quickly reach opportune voltage and frequency conditions whenever a grid failure demands it has to start-up. Once those parameters have been established, it can maintain them as long as it is operating. When deciding on the size of the engine, one should not only take into account those aspects of this application that we have looked at above, rather we should also bear in mind those environmental aspects that are common to all applications such as the ambient temperature and the altitude.

The **start-up** is relevant when choosing engines for this type of application where reliability is crucial. In actual fact, HIMOINSA can improve the start-up included as standard in engines by incorporating redundant systems with two electrical motors with independent battery systems or the combination of an electric motor and another pneumatic or hydraulic starter.

Choosing maintenance-free batteries that are supplied with a good level of current on start-up is also vital. In addition, in order to facilitate the task of the starter and to achieve a rapid start-up and to ensure the load is accepted in as

short a period of time as possible, it is important, as is the case in any stand-by application, to use heating resistors for the cooling liquid found in the engine block. In this way, the engine will be at the optimum temperature in the event of a grid failure. A pump that helps the coolant to circulate can be added to the resistance, thereby cooling the block in a more uniform way. Finally, proper prior lubrication using an oil pump will also improve the start-up.

The **alternator** is of course the other key element in a generator set. An effective AVR (Automatic Voltage Regulation) card will keep the voltage variation at values below 0.5% and a well-designed and manufactured winding will maintain low values of harmonic distortion and interference with telecommunications. The use of a permanent magnet (PMG) will ensure a supply to the AVR that is independent of the main winding and reliable in the event of sudden loads, thereby guaranteeing good excitation power to the regulator at all times.

A good priming on the winding, IP23 enclosures and even anti-condensation resistances are vital if the alternator is to last, particularly in zones with high levels of ambient humidity.

The **cooling package** that we choose is also important in facilities of this type as generator sets are sometimes located on the ground floor or underground, with limited openings to allow air to flow in freely from outside. That is why manufacturers of generator sets have to have a good team of engineers and experience in designing remote cooling systems located in upper floors or on the roof, that cool the engine by means of intercoolers and secondary circuits.

The **control unit** of the set is responsible for controlling, measuring and handling

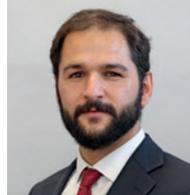
all these elements. There are different brands of control units in the market, for different applications. HIMOINSA has its own control units that are specially designed to control its generator sets and which can also detect grid failures in order to give the order to start up the generator set. It is possible for these control units to include different communication protocols in order to integrate the generator set, its operating parameters and the alarms in the building's installation management systems. They can also be remotely monitored and controlled.

Conclusions

The more sensitive the data that a Data Center handles and the more important it is that this data should be available at any given moment, the greater the need for reliable energy facilities to power the equipment continuously and in the event of an emergency. As it constitutes a fundamental part of facilities of this type, the size of the generator set must be based on those same criteria. At this stage, it is the power declaration for which the set has been sized that will tell us the level of availability that it offers, depending on the criteria laid down by the Uptime Institute. Thus, while a generator set that is sized in accordance with its stand-by power will meet Tier I and II requirements, if it is to achieve the highest levels of availability, Tier III and IV, it will have to be sized in accordance with its DCC power.

HIMOINSA manufactures generator sets that meet market standards and the highest levels laid down by the Uptime Institute and can provide the advice you need on what installation type best suits the needs of your Data Center ■

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