WHITE PAPER

by David Matuseski

Data Center Continuous (DCC) Ratings

A comparison of DCC ratings, ISO definitions and Uptime requirements

While Uptime Institute references the ISO8528-1 definitions for generator ratings in their publication Tier Standard: Topology, they do not require the use of these definitions for generators to meet the Tier III and Tier IV requirements, as described in the same publication. A more cost-effective and reliable generator rating that meets the Tier III and Tier IV requirements can be achieved when the generator manufacturer develops ratings specifically for data center applications.

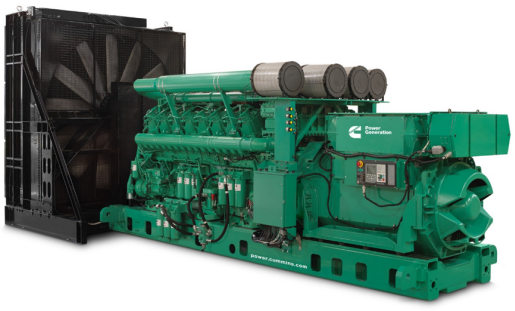

Figure 1. Cummins QSK95-based generator sets offering ratings up to 3.5 MW based on ISO 8528-1

Diesel generators in a Tier III or Tier IV system

In Tier III and Tier IV systems, Uptime Institute defines the diesel generators as the primary source of power and the utility as an economic alternative. This definition puts two important requirements on the diesel generators. First, they must be large enough to carry the entire data center load. Second, there can be no limit on the number of hours the diesel generators can run.

ISO8528-1

In their Tier Standard: Topology publication, Uptime Institute references the Continuous (COP), Prime (PRP) and Standby (ESP) generator rating definitions of ISO8528-1. Of these ISO definitions, the only rating that meets Uptime Tier III or Tier IV at 100 percent of the generator rating is Continuous. The ISO Prime rating definition states that the generator can run continuously if the average load does not exceed 70 percent of the full generator prime rating in any 24-hour period. The ISO Standby definition limits the run-time to no more than 200 hours per year, plus it limits the generator to no more than 70 percent average power during any 24-hour period. See Figure 2 for a comparison table of the ISO8528-1 ratings.

In 2018 ISO added a new rating called Data Centre Power, to the standard. Although it is intended for use in the data center market this rating is not appropriate for Uptime Institute Tier III or Tier IV certification. The rating definition makes reference to availability of a reliable utility and prohibits prolonged operation in parallel with a utility. A core premise set forth by Uptime Institute is that the only reliable source of power is that generated on site. For this reason, any limitation on operation of the generator set or dependence on a utility is not acceptable for Tier III or Tier IV certification.

The Continuous definition describes a constant load with no variance. In Tier III and Tier IV data centers, the generators need to be sized for the maximum load (they are the primary source of power), but this maximum load will not be the constant load of the facility. Therefore, if the COP rating is used to specify the size of the data center generators, these generators are most likely oversized for the application.

It is important to note that Uptime Institute references the ISO definitions, but they do not require Tier III and Tier IV generator ratings to be defined by ISO.

ISO generator rating	Run-time limitations	Load rating
ISO Continuous (COP)	No limit on run-time at 100% of generator rating	Rated for a constant load
ISO Prime (PRP)	No limit on run-time at 70% or less of generator rating	Rated for a variable load
ISO Standby (ESP)	Allows no more than 200 hours of run-time per year	Rated for a variable load

Figure 2. ISO 8528-1 definitions for continuous, prime and standby power ratings

No limit on run-time

The Tier Standard: Topology publication also states that the generator manufacturer's certification of capacity at an unlimited duration will be used to determine compliance with the applicable Tier requirements. This statement allows a generator manufacturer to design and rate a generator that more closely fits the needs of a data center and still meet the Tier III and Tier IV requirements. The Uptime Institute will also accept a site specific rating for a generator set. In this scenario, the manufacturer submits a letter stating that there is no limit to run time for the generator set at a particular rating at a particular site. See a typical load profile of a data center in Figure 3. When the generator manufacturer provides a generator with no run-time limit that is sized closer to the site load and can still supply the maximum load spikes, the data center gets the most efficient use of their generator system.

Some generator manufacturers start with the ISO Prime rating and reduce this rating by a certain percentage to achieve the no run-time limit requirement. Some manufacturers will provide a non-ISO defined rating that guarantees no run-time limit at 100 percent of that rating. These methods are discussed in section 3.3 of Uptime Institute's Tier Standard: Topology publication. These unlimited duration ratings from the generator manufacturer will be used to determine compliance with Tier III and Tier IV requirements. Cummins has a complete line of high-horsepower generators with a Data Center Continuous (DCC) rating meeting these requirements. Detailed specification sheets are available for these generators in Cummins Power Generation's online resource, Power Suite (powersuite.cummins.com).

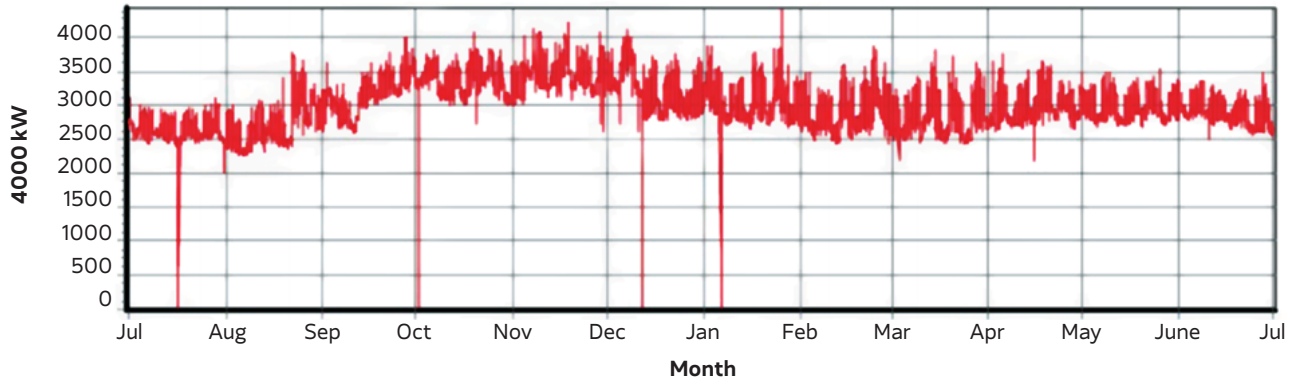

Figure 3. Typical data center load profile

The graph in Figure 4 compares a system with 2,500 kW DCC rated generators to a system with 2,500 kW ISO Prime (PRP) rated generators. This graph shows that this system requires four 2,500 kW DCC-rated generators to meet demand, whereas five 2,500 kW ISO Prime rated generators would be required to meet the same demand with no run-time limit.

Oversized generators

As stated before, an ISO Continuous (COP) rated generator does meet the no run-time limit for Uptime Tier III and Tier IV. But a COP rated generator may not be the best fit for a typical data center load profile, nor does Uptime Institute require generators to be ISO COP rated. There are optimum load levels for running diesel generators. One rule of thumb for optimum engine life is that the generator engine should be run greater than 30 percent of its maximum horsepower rating. This ensures that the exhaust temperature will be high enough to burn up the majority of particulate in the exhaust. Incomplete combustion at low loads can cause increased valve wear and degradation in the turbochargers, both of which increase maintenance needs and decrease reliability. In Figure 5, we compare a system utilizing five 1.6 megawatt COP rated generators to a system utilizing five 1.6 megawatt DCC rated generators. The load shown is about 36 to 39 percent of the generator system's 100 percent rating. This light load is very common in real-world data centers. As the graph shows, the COP rated generators are running below 30 percent of their maximum horsepower, while the DCC rated generators are running above 30 percent of their maximum horsepower. The DCC rated generator system is the more reliable choice in this example, and it will operate closer to the optimum horsepower of the engines, reducing the risk of low load failures.

Choose the most efficient generator for your data center

To summarize, it is best to choose generators that most closely fit the load profile of your data center and still meet the Uptime Tier III and Tier IV standards. This will provide the most value. Plus, the generators will run closer to their optimum load level, which will increase the life and reliability of the generators.

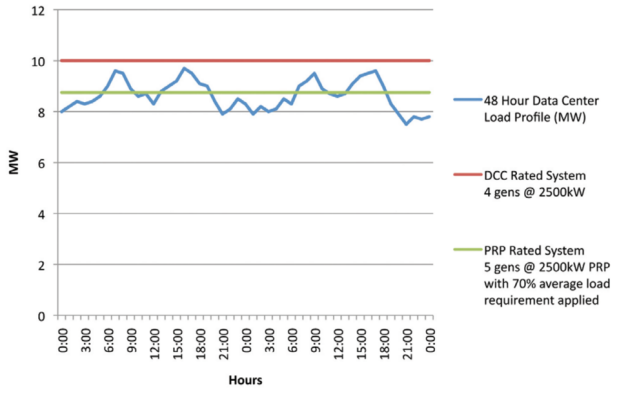

Figure 4. Cummins Data Center Continuous (DCC) rating vs. ISO Prime (PRP) rating

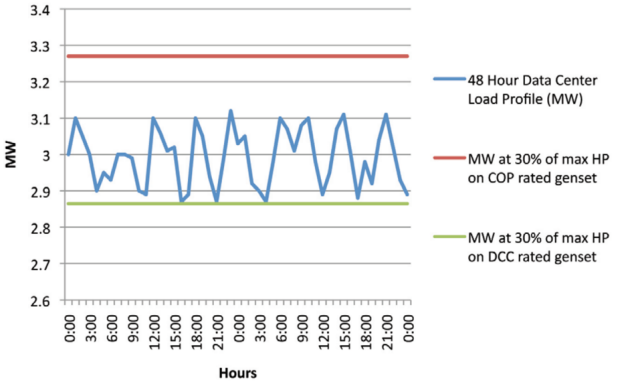

Figure 5. Cummins Data Center Continuous (DCC) rating vs. ISO Continuous (COP) rating

About the author

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David Matuseski is the Engineering Director for the Distributed Generation group at Cummins Inc. He provides technical expertise on the integration of all types of energy resources and distribution equipment within power systems. Dave has been working in the power industry since 1996 and is a registered Professional Engineer in the state of Minnesota. He graduated from the University of Minnesota with a Bachelor of Electrical Engineering. Within Cummins, Dave has held the positions of Design Engineer, Project Manager, Engineering Manager, Chief Engineer, and Mission Critical Technical Leader.

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