Generator Set Ratings for Data Centers and Other Applications

PowerHour webinar series for consulting engineers
Experts you trust. Excellence you count on.

DATE 11:00 PDT / 13:00 CDT
(1PDH issued by Cummins)
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▪ If you lose audio, get disconnected, or experience a poor connection, please disconnect and reconnect
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Meet your panelists

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Sales Application Engineer
Cummins Inc.

Rich Scroggins
Technical Advisor - Data Center Markets
Cummins Inc.

Ariel Gastelum
Channel Development & Sales Support Analyst
Cummins Inc.

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Disclaimer

The views and opinions expressed in this course shall not be considered the official position of any regulatory organization and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Participants are encouraged to refer to the entire text of all referenced documents. In addition, when in doubt, reach out to the Authority Having Jurisdiction.
Course Objectives

Generator Set Ratings for Data Centers and Other Applications

One of the first steps to a successful generator set application is selecting the appropriate generator set rating. This PowerHour will guide participants through the industry standards that define generator set ratings; such as ISO 8528-1 along with other industry adopted ratings. In particular, the instructors will discuss Uptime Institute generator set rating requirements for Tier III and Tier IV data centers as well as industry responses to those requirements.

After completing this course, participants will be able to:

• Define generator set ratings per ISO 8528-1 and identify their appropriate applications
• Recognize industry adopted ratings outside of ISO 8528-1
• Describe the impact of Uptime Institute Tier certifications on generator set ratings requirements
What factors impact generator set ratings?
Factors Affecting Choice of Generator Set Rating

- Annual Generator Set Run Time
- Applied Load (Variable or Constant)
- Negotiated Contracts (Rate Curtailment Programs)
Engineering Optimization: Flexibility vs Standard Offerings

• Near infinite possibilities exist for taking an engine and alternator and creating a generator optimized between:
  • Max Power Rating
  • Performance (loads, derate, etc.)
  • Emissions constituents

• Standard offerings for products tend to default to a legal requirement for emissions, and performance that can serve most market needs.

• Max power also has one more layer of optimization, between duty cycle and life, established by the manufacturer’s engineering standards.
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Industry Standard for Generator Set Ratings

- ISO 8528-1: Defines application, ratings and performance of generator sets
  - Emergency Standby Power (ESP)
  - Prime Rated Power (PRP)
  - Limited Time Prime Power (LTP)
  - Continuous Operating Power (COP)
  - Data Centre Power (DCP)
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Include ISO 8528-1 power rating definitions in specifications
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![Graph showing load profiles](image)

- **Variable Loads**: 100% Load
- **70% Average**: Load
- **Constant Loads**: 100% Load
Emergency Standby Power (ESP)

- “Maximum power available during a variable electrical power sequence…for up to 200 h of operation per year”
- “The permissible average power output over 24 h of operation shall not exceed 70% of the ESP unless otherwise agreed by the RIC engine manufacturer”
- Examples for ESP applications include life safety, legally required, or critical loads
- Not required by the Authority Having Jurisdiction (AHJ), but desired to minimize economic losses or equipment damages at a site due to utility power interruptions

![Chart showing load profile and run hours for different power ratings](chart.png)
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Prime Rated Power (PRP)

- "Maximum power which a generating set is capable of delivering continuously while supplying a variable electrical load when operating for an unlimited number of hours per year”
- Examples include applications that use on-site generation in lieu of a utility electricity supply, typically where utility power is not available.
- Peak shaving and rate curtailment programs
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**Limited Time Prime (LTP)**

- “Maximum power available, under the agreed conditions, for which the generating set is capable of delivering for up to 500 h of operation per year”
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- “Maximum power which the generating set is capable of delivering continuously while supplying a constant electrical load when operated for an unlimited number of hours per year”
- Examples of COP applications include paralleling to the utility, base loading, or combined heat and power (CHP)

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The Cummins Power Generation lean-burn generator set produces up to 1.76 MW of electricity and 4,000 pounds of steam per hour in a CHP application.

The lean-burn engine's radiator and critical exhaust silencer are roof mounted.

Combined heat and power - Chicago Museum of Science and Industry
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• “Prolonged operation at load in parallel with a utility is not permitted”
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When selecting a generator set rating, what are some factors that would influence the correct decision?

a) Hours of intended operation
b) Load profile
c) Available power at output terminals
d) All of the above
Concept Check

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When looking at generator set ratings, make sure to ask yourself…

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Are there applications for which none of the ISO 8528-1 ratings are appropriate?
Uptime Institute Tier Ratings

- The Uptime Institute tier rating system is an industry standard for benchmarking data center reliability
- Four tiers specifying levels of redundancy

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- **Tier III** - Concurrent Maintainability
  - Every power distribution component can be removed or replaced during a planned event without loss of service to IT or cooling loads.

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Four tiers specifying levels of redundancy:

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- **Tier IV** - Fault Tolerant (Uptime Institute Tier IV)
  - No single fault on any piece of equipment will result in loss of service to IT or cooling loads.

### Table of Uptime Institute Tier Ratings

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Generator Sets for Uptime Tier III or Tier IV Systems

Uptime Institute

• “The only reliable source of power for a data center is the on-site energy production”

• “Disruptions to the utility power are not considered a failure but an operational condition for which the site must be prepared”

• “A Tier III or Tier IV engine-generator system, along with its power paths and other supporting elements shall meet … performance confirmation tests while they are carrying the site on engine-generator power”

• “Engine-generators for Tier III and Tier IV sites shall not have a limitation on consecutive hours of operation when loaded to ‘N’ demand”
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ISO 8528-1 Data Centre Power Rating

Data Centre Power (ISO 8528-1)

- “Depending on the sites to supply and the availability of reliable utility, the generating set manufacturer is responsible to define what power level he is able to supply”
- “Prolonged operation at load in parallel with a utility is not permitted”

Because ISO 8528-1 Data Centre Power Rating references a reliable utility, it is not sufficient for Uptime Institute Tier III or Tier IV Certification
ISO 8528-1 Ratings and Uptime Institute Tier III and IV Certification

Are these ratings sufficient for Uptime Certification?

- Emergency Standby Power (ESP)
- Prime Rated Power (PRP)
- Limited Time Prime Power (LTP)
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ISO 8528-1 Ratings and Uptime Institute Tier III and IV Certification

Are these ratings sufficient for Uptime Certification?

- Emergency Standby Power (ESP) – No
  - 200 hr run time limitation
  - Maximum average power output of 70% of rating
- Prime Rated Power (PRP)
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ISO 8528-1 Ratings and Uptime Institute Tier III and IV Certification

Are these ratings sufficient for Uptime Certification?

- Emergency Standby Power (ESP) - No
- Prime Rated Power (PRP) - No
- Limited Time Prime Power (LTP) - No
  - 500 hr run time limitation
- Continuous Operating Power (COP)
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ISO 8528-1 Ratings and Uptime Institute Tier III and IV Certification

Are these ratings sufficient for Uptime Certification?

- Emergency Standby Power (ESP) - No
- Prime Rated Power (PRP) - No
- Limited Time Prime Power (LTP) - No
- Continuous Operating Power (COP) – Yes
  - Results in an oversized, underloaded generator set
  - Sufficient for Uptime certification but not appropriate for a data center application
- Data Centre Power (DCP)
ISO 8528-1 Ratings and Uptime Institute Tier III and IV Certification

Are these ratings sufficient for Uptime Certification?

- Emergency Standby Power (ESP) - No
- Prime Rated Power (PRP) - No
- Limited Time Prime Power (LTP) - No
- Continuous Operating Power (COP) – Yes
- Data Centre Power (DCP) – No
  - References availability of a utility
Data Center Continuous Ratings

- Data Center Continuous (DCC) Ratings meet the Uptime Institute Tier III and Tier IV requirements.
- Data Center Continuous (DCC) Rating is defined as:
  - *The maximum power which the generator is capable of delivering continuously to a constant or varying electrical load for unlimited hours in a data center application.*
Data Center Continuous (DCC) Ratings meet the Uptime Institute Tier III and Tier IV requirements.

Data Center Continuous (DCC) Rating is defined as:

- The maximum power which the generator is capable of delivering continuously to a constant or varying electrical load for unlimited hours in a data center application.

### Specification sheet

**Diesel generator set**

**QSK95 series engine**

- **Model:** C3500 D6e
- **Frequency:** 60 Hz
- **Fuel type:** Diesel
- **kW rating:**
  - 3500 standby
  - 3000 prime
  - 2750 continuous

**Features**

- **Data Center Continuous (DCC)**: Applicable for supplying power continuously to a constant or varying electrical load for unlimited hours in a data center application.
- **Uptime Compliant**: Meets the requirement of a Tier III and IV data center site by being rated to run for unlimited hours of operation when loaded to "N" demand for the engine generator set.
## Case Study: ISO Ratings in Data Center Applications

<table>
<thead>
<tr>
<th>Generator Set Model</th>
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- Maximum Connected Load: 2500 kWe
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- Maximum Connected Load: 2500 kWe
- Typical Load: 1900 kWe
- Site Capacity: N+1 (2 paralleled generator sets)
- Generator Set Load: 950 kWe (less than 30% engine load)
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- Maximum Connected Load: 2500 kWe
- Typical Load: 1900 kWe
- Site Capacity: N+1 (2 paralleled generator sets)
- Generator Set Load: 950 kWe (greater than 35% engine load)
Generator Set Ratings for Tier III and Tier IV Certification

Generator Set Rating

- Must have no run time limitation while operating at full rated load
- Must not be dependent on the presence of a utility

Uptime Institute will accept site specific rating for Tier III or Tier IV certification

- Manufacturer issues a letter stating that there is no run time limitation for the generator set at the designated site
- Letter is only valid for the data center listed in the letter

Spec Note Generator set shall have no run time limitation when operating at rated load and must not be dependent on the presence of a utility
Concept Check

What are the advantages of specifying a Data Center Continuous (DCC) generator rating for applications requiring Uptime Institute Tier III or Tier IV certification?

a) The DCC rating has no run time limitation at rated load
b) The DCC rating does not reference an available utility
c) Specifying a DCC rating drives selection of an appropriately sized generator set rather than an oversized, underloading generator set
d) All of the above
Concept Check

What are the advantages of specifying a Data Center Continuous (DCC) generator rating for applications requiring Uptime Institute Tier III or Tier IV certification?

a) The DCC rating has no run time limitation at rated load
b) The DCC rating does not reference an available utility
c) Specifying a DCC rating drives selection of an appropriately sized generator set rather than an oversized, underloading generator set
d) All of the above
Course Summary

Generator Set Ratings for Data Centers and Other Applications
- Define generator set ratings per ISO 8528-1 and identify their appropriate applications
- Recognize industry adopted ratings outside of ISO 8528-1
- Describe the impact of Uptime Institute Tier certifications on generator set ratings requirements
- Consult generator set manufacturer for site specific ratings

Specify:
- Specify generator set ratings based on intended use, load profile, and hours of operation
- Generator set shall have no run time limitation when operating at rated load (when Uptime Institute certification is required)

Avoid specifying:
- ISO 8528-1 Data Centre Power (DCP) if Uptime Institute certification is required
- A generator set rating that does not meet ALL requirements
Additional Resources

Cummins White Papers

• Understanding ISO 8528-1 Generator Set Ratings (Nov 2019)
• Data Center Continuous (DCC) Ratings: A Comparison of DCC Ratings, ISO Definitions and Uptime Requirements (Nov 2019)

Cummins On-Demand Webinars

• Common Failure Modes of Data Center Back Up Power Systems
• NFPA 110 Time to Readiness
• NEC 2017 Code Changes for Emergency Power Systems
• Introduction to Generator Set Sizing Software
Q&A

Type your questions, comments, feedback in the **WebEx Q&A box**. We will get to as many questions as we can. We will publish consolidated FAQ along with presentation and webinar recording on [powersuite.cummins.com](http://powersuite.cummins.com).

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- For other states and territories, email powergenchannel@cummins.com or visit [http://power.cummins.com/sales-service-locator](http://power.cummins.com/sales-service-locator)
Closing

Watch out for a follow-up email including:
  • A Link to webinar recording and presentation
  • A PDH Certificate

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  • Other Cummins Continuing Education programs
  • Sizing and specification development tools

Upcoming PowerHour Webinars:
  • November – Look out for more information in upcoming newsletter
  • December – Distributed Generation Applications (Microgrids)

Please contact Mohammed Gulam if you have any questions related to the PowerHour webinar (mohammed.gulam@cummins.com)