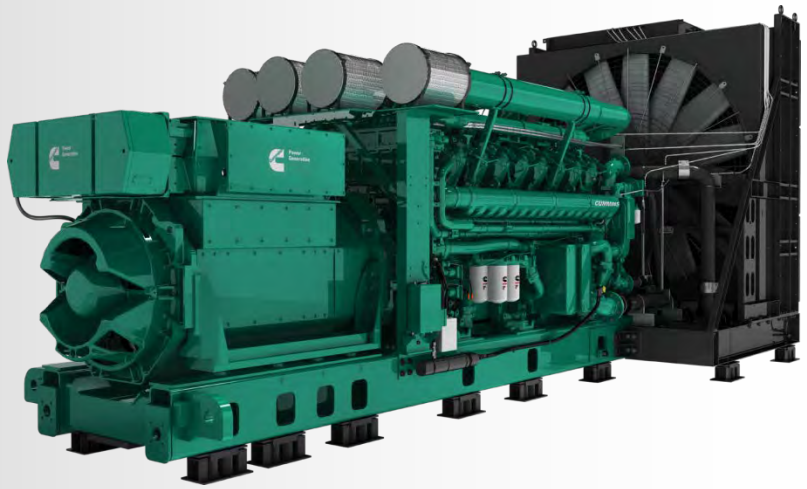
Power Generation

CUMMINS
FOCUS ON DATA CENTER POWER

Wojtek Goralski – Key Account Manager Data Centers

The Power of More™



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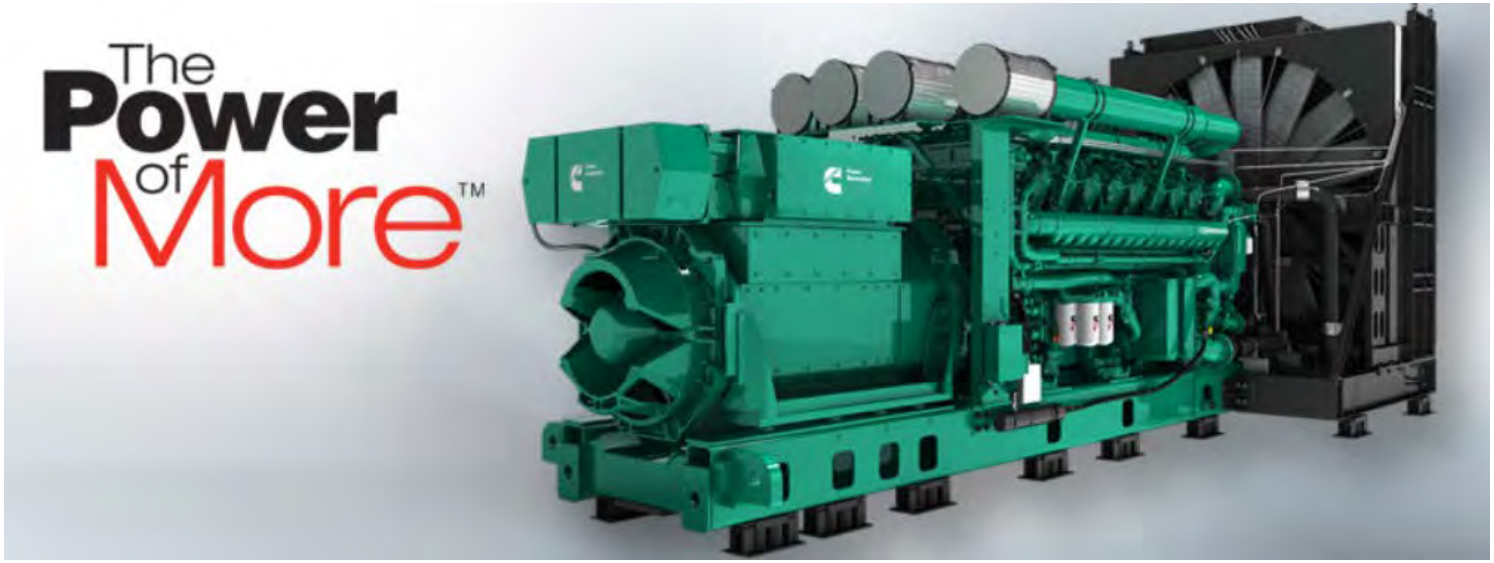
If You Build It Bigger,



They Will Come

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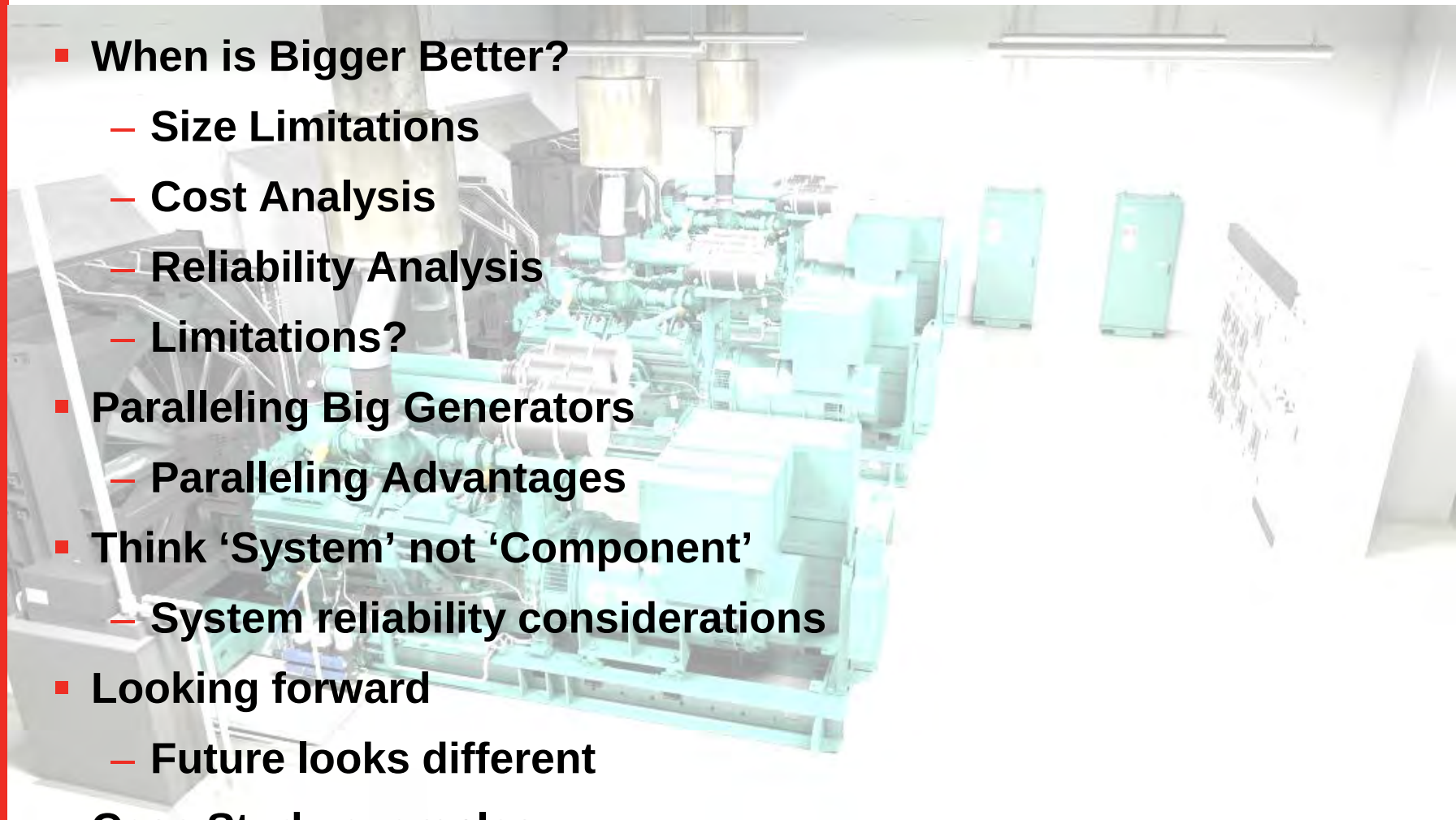
Cummins Power Generation

Agenda

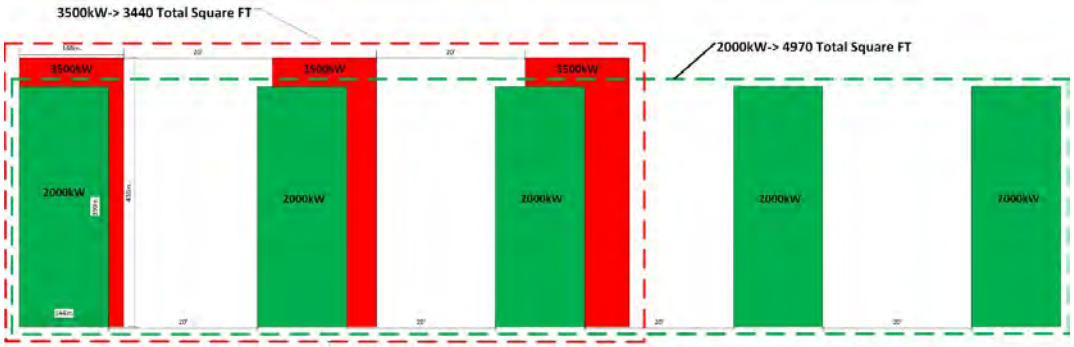


- When is Bigger Better?
  - Size Limitations
  - Cost Analysis
  - Reliability Analysis
  - Limitations?
- Paralleling Big Generators
  - Paralleling Advantages
- Think ‘System’ not ‘Component’
  - System reliability considerations
- Looking forward
  - Future looks different
- Case Study examples

Size Limitations

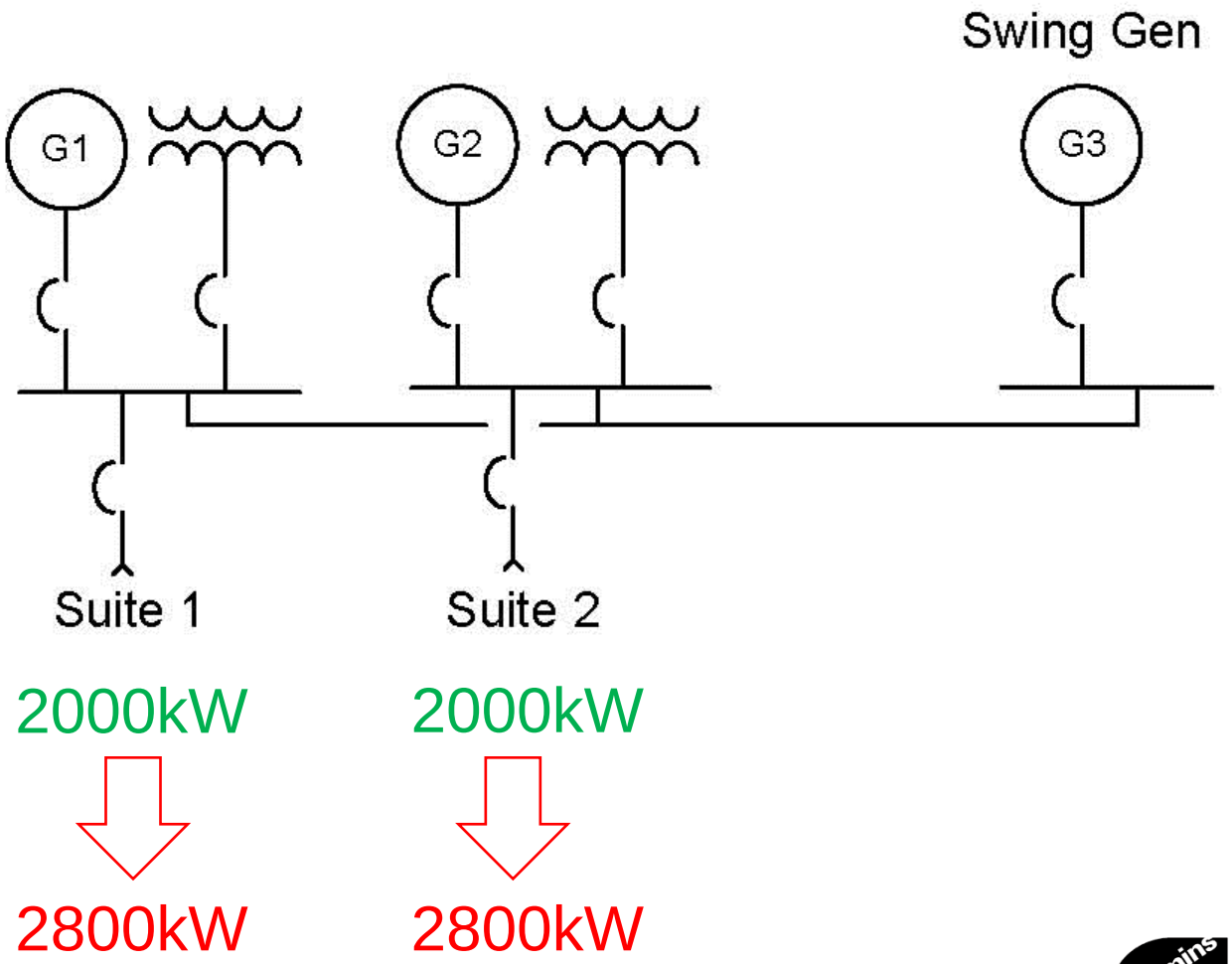
- Existing Building

- New Construction



Size Limitations

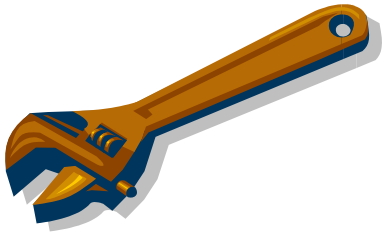
- Matching Your Load



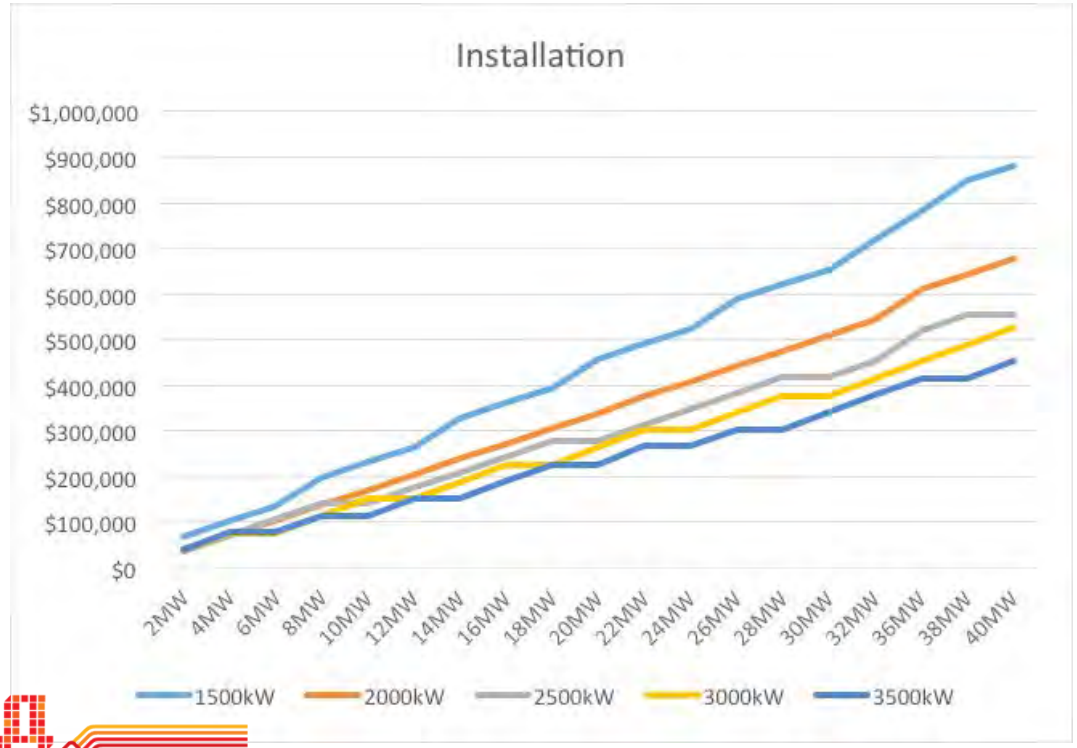
Cost Analysis

- CapEx

Installation



Equipment



Cost Analysis

- OpEx

Maintenance

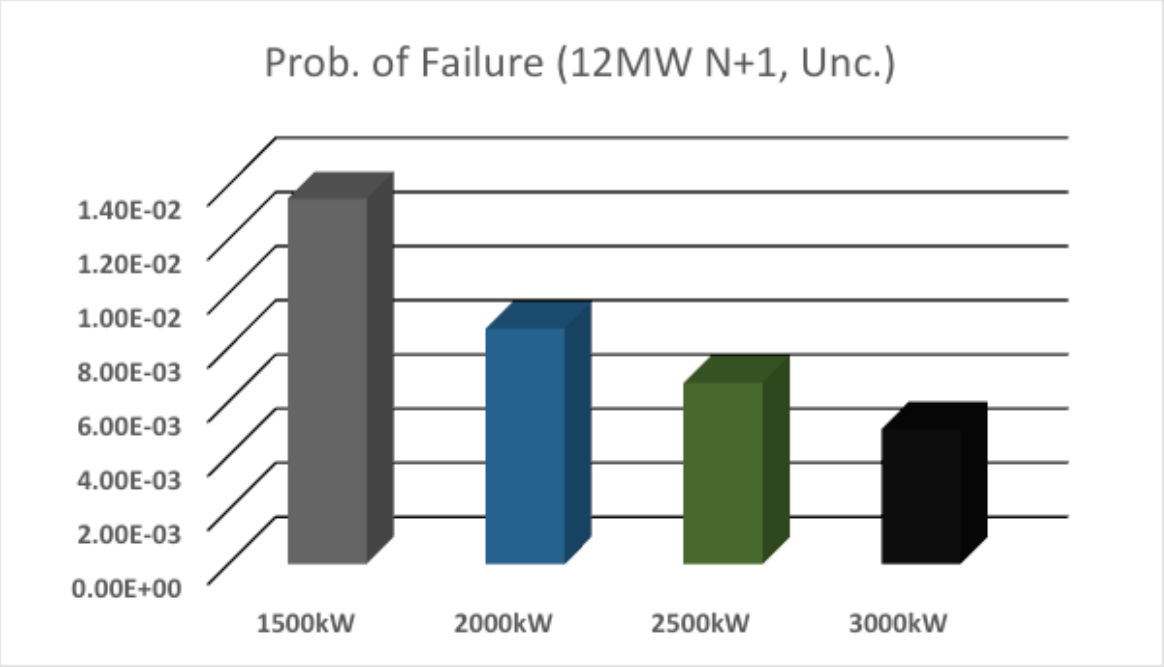
Generator Size	Annual Maintenance Cost per Generator	Number of Generators for 10 megawatts	Total Annual Maintenance Cost
1500 kW	$6,802	7	$47,614
2000 kW	$8,788	5	$43,940
3000 kW	$10,618	3	$31,854

Fuel

Generator Size	Prime Application: 1000 Hours per Year at ¾ load	Standby Application: 100 Hours per year at ¾ load
1500 kW	$2,585,330	$258,533
2000 kW	$2,503,550	$250,355
3000 kW	$2,439,850	$243,985

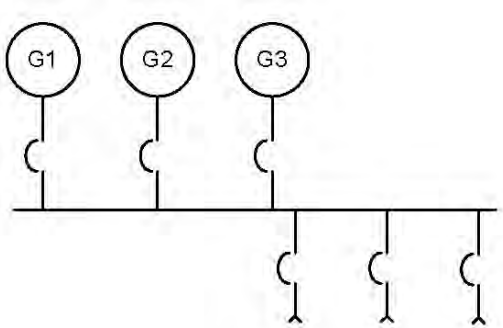
Reliability

- Perception: Less Equipment = Higher Reliability
- Reliability Study:



- Limitations?

Paralleling Generators

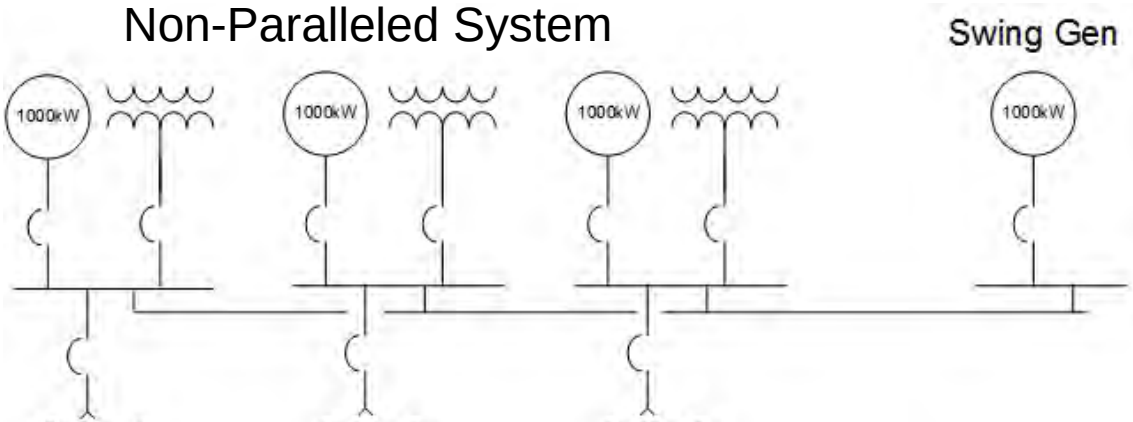


- Advantages

1	Efficiency	More efficient use of your generator power. Less chance of having stranded generator capacity
2	Reliability	You are not dependent a single generator. If one generator fails, you still have all the others to power your load.
3	Redundancy	Creating an N+1 or N+2 configuration is very straight forward in paralleling designs.
4	Performance	A large generator bus will act more like a utility. There will be less frequency and voltage variations during load steps.
5	Scalability/ Expandability	Easy to add generators to a paralleling architecture as power demand increases.
6	Serviceability	A single generator can be serviced while the remaining generators are available to provide power.

Paralleling Generators – Efficiency Advantage

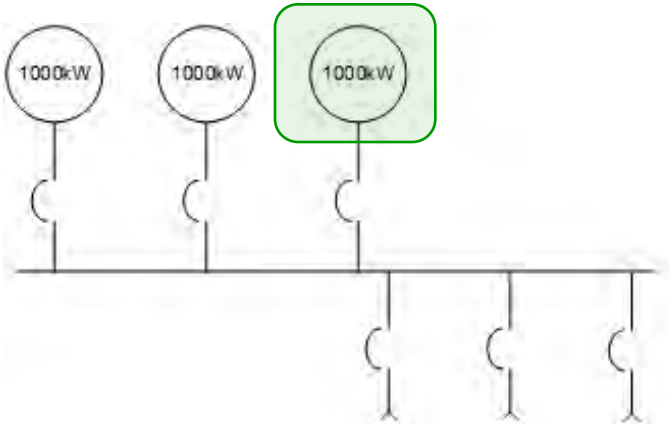
Non-Paralleled System



25% 40% 50%

Capacity 3000kW — Usage 1150kW = Excess Capacity 1850kW

Paralleled System



Capacity 2000kW — Usage 1150kW = Excess Capacity 850kW

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System vs Component

Reliability Considerations

- DRUPS, Static UPS, Generators?
  - MTBF
  - Trends
  - Good night sle

What next….

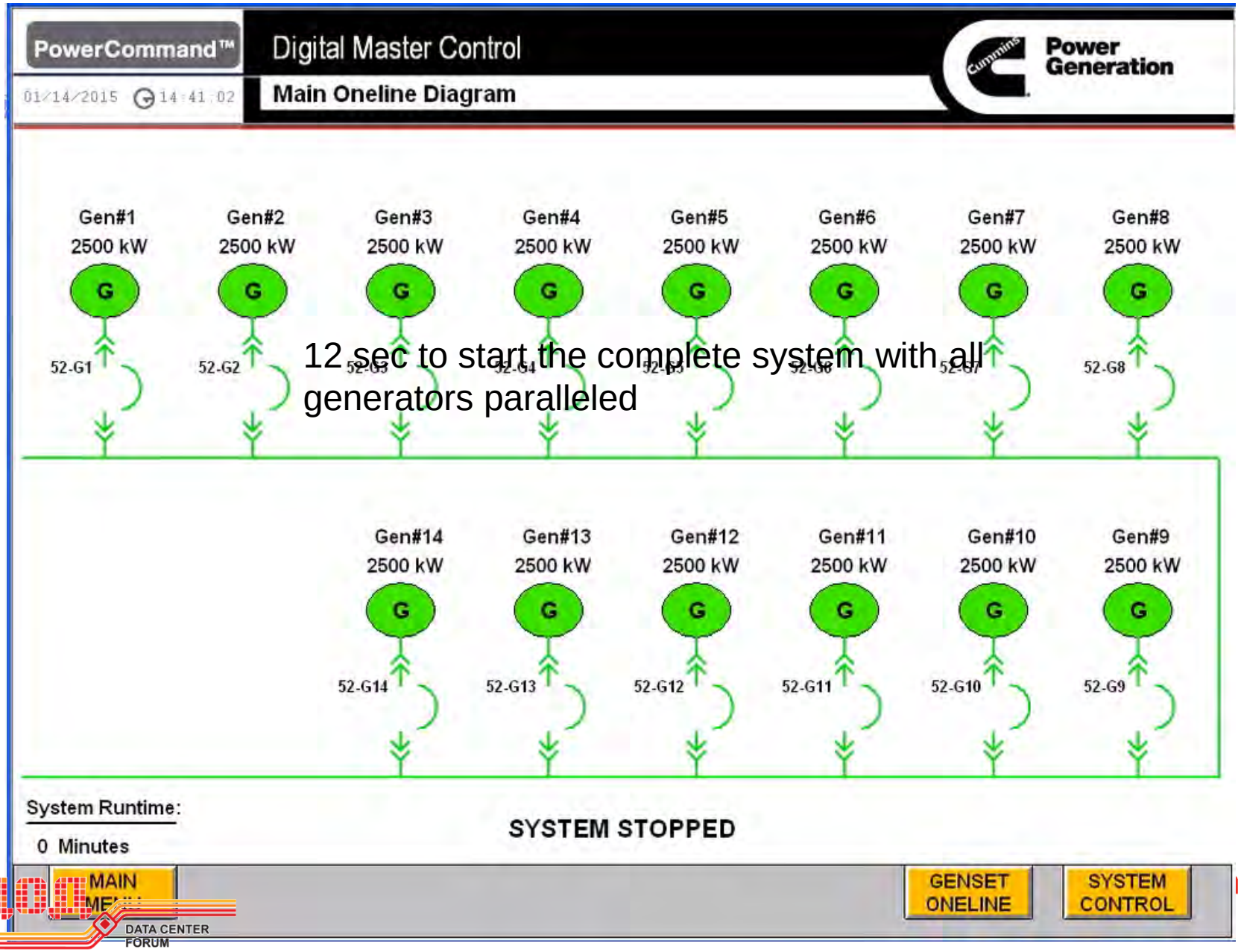
- Global demand for DC and power grows
  - More conventional power supply?
  - Constrains?
  - OR
  - Alternative energy sources?
  - Solar
  - Wind
  - Fuel cells….

Example - Paralleling 35MW of power

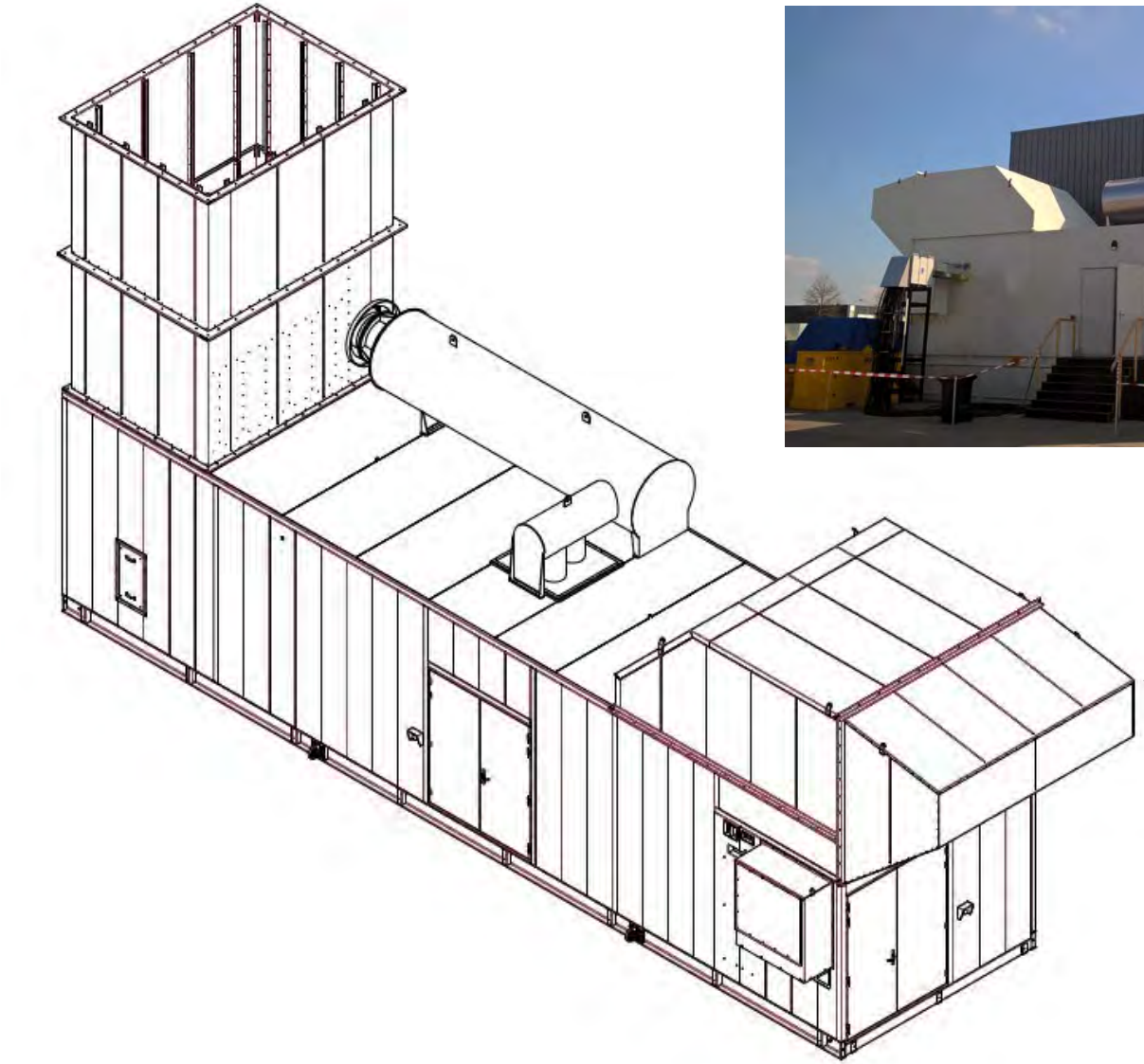
How much is 35MW of power?
Enough to Power and Heat
14,700 homes

- 14 generators rated at 2.5MW each (35MW)
- All start at same time
- First Gen ready, closes and energizes the paralleling bus
- All the other generators synchronize to the energized paralleling bus

35MW Paralleling System



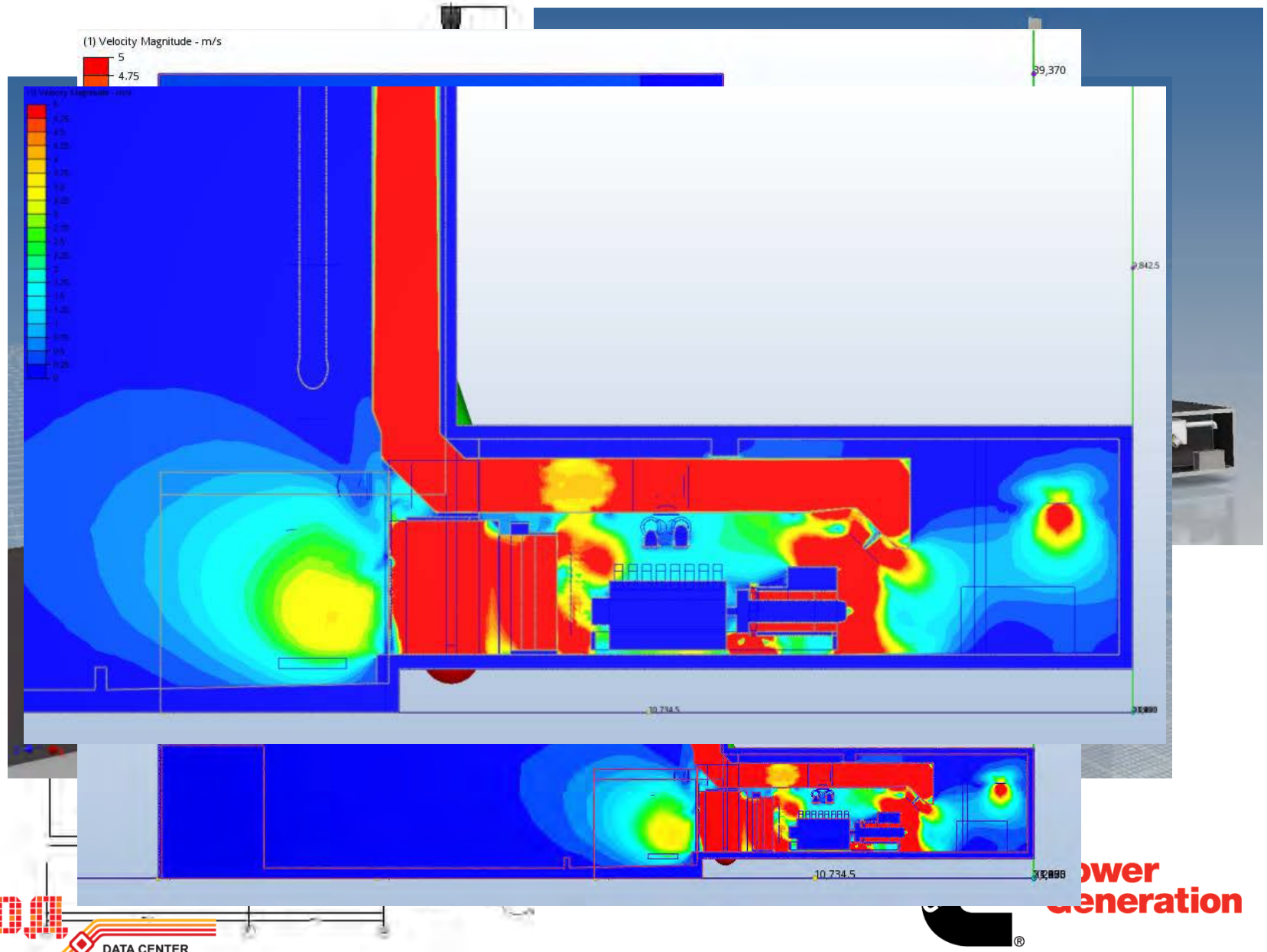
Talking about big Generators



2800kW Generators

Holland – 50 units installed
Another 24 by end of 2017

Talking about challenging installations



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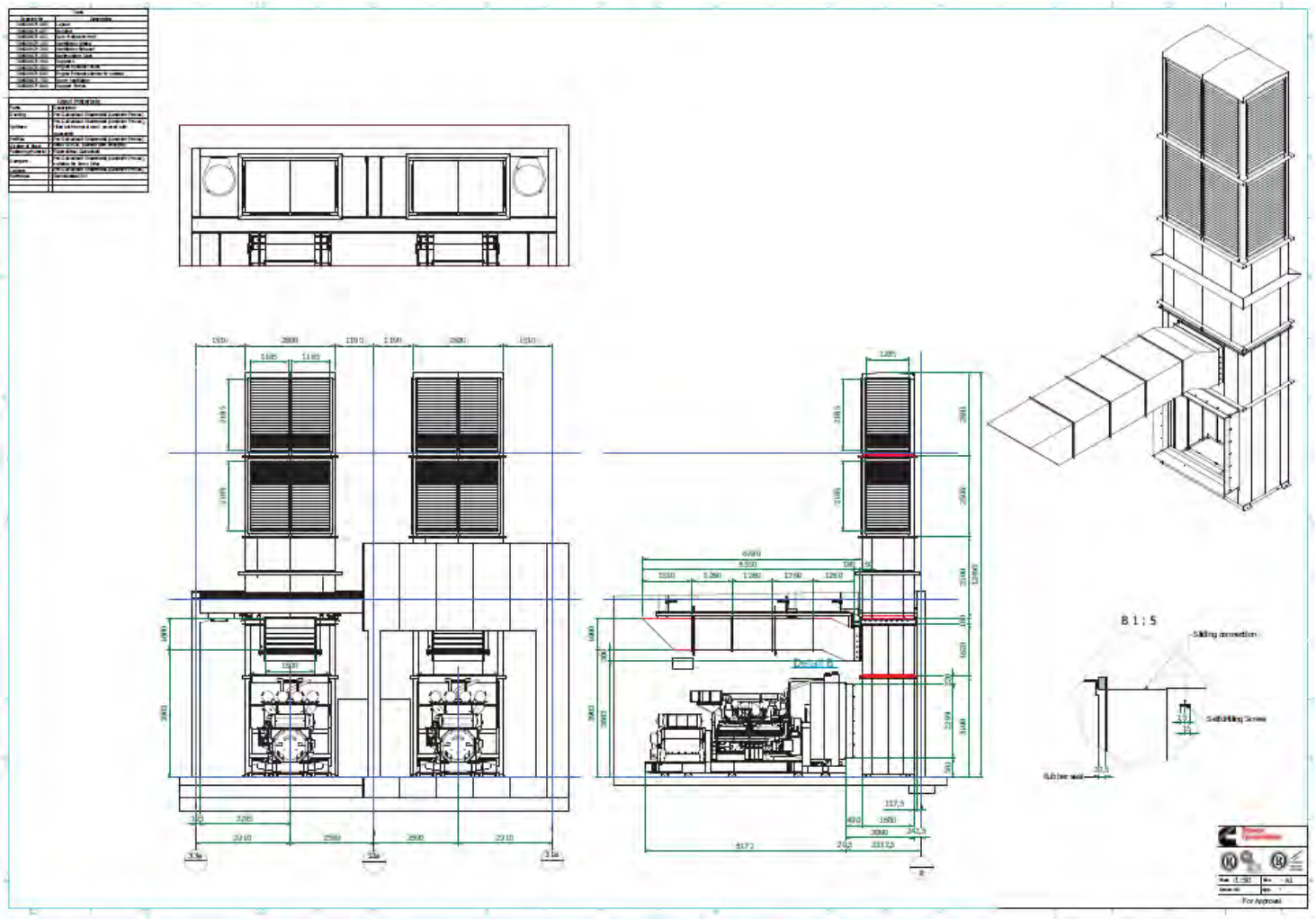
ower generation

And another one…



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Data Center– Case Study

CoreSite LLC, Chicago, Illinois

What:

8 MW of standby power from a system with four DQKAB 2 MW generator sets and a DMC 200 paralleling system including five sections of UL891 draw-out switchgear. The paralleling switchgear includes four feeds to downstream breaker transfer pairs.

Purpose:

A dependable backup power source to ensure CoreSite's data center clients have the power they need during a utility outage with no interruption to the critical load.

Primary choice factors:

A company that would provide a reliable solution; a source of temporary power during the decommissioning, installation and commissioning of the old and new systems; and a commitment to meet its deadlines and agreements.

"We had several meetings with Cummins, the designers, structural engineer, mechanical engineer, contractors, and with the owner and staff on-site and it was really like a well conducted orchestra."

Data Center – Case Study

Dataplex, Budapest, Hungary

What:

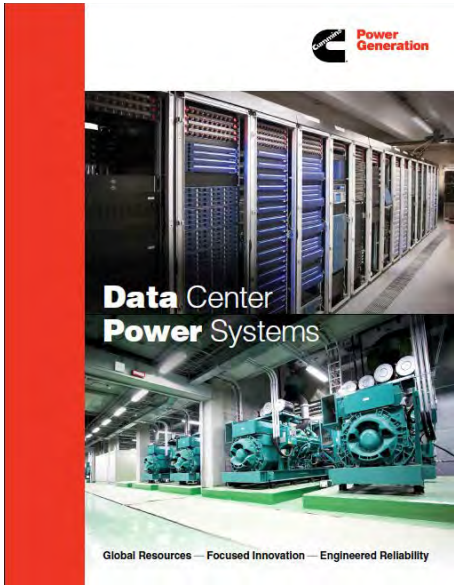
Four generator sets, model C2000 D5 powered by a QSK60 engine. Generator set controls include a DMC 300 digital master control system, switchgear and utility paralleling.

Purpose:

Provision of reliable source of standby power for Hungary's largest data center to ensure all operations are unaffected in the event of a power blackout

Primary choice factors:

- Proven reliability and quality of Cummins Power Generation products
- Ability for installation to meet unique requirements of project such as low noise emission factor
- Cummins Power Generation's ability to provide short time to market delivery to meet specific customer requirements



- Website
  - www.cumminsdatapower.com
- Brochure
- DCC Ratings

Continuous Power Ratings Tailored to Data Center Requirements

Cummins Power Generation has developed a new diesel generator power output ratings category for data center applications to ensure total reliability and dependability for data center operators. The Data Center Continuous (DCC) rating offers diesel generator sets rated for unlimited hours of operation, with no restrictions on average variable load factor. DCC ratings are applicable for any data center installation where a reliable utility exists. The new ratings greatly simplify the engineering design process and make it easier for customers to achieve site certification from the Uptime Institute.