Direct Current Solutions for the Data Center

Presented by:

* Agenda *

- Challenges in Today's Data Center
- What is DC Power?
- Benefits of DC Power Distribution
- AC vs. DC Distribution Systems
- DC System Arrangements
- DC Design Considerations

Presenter Information

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Data Center Problems/Power Trends

- Increasing operating and installation costs
- Reduced reliability/low availability
- Existing power distribution systems have a low end-to-end efficiency
  - – Heat is the ENEMY!
  - Legacy systems can't support high density load requirements
  - Current power demands vary from 7 to 15 kW per rack or 200+ watts per square foot
  - 2010 initiatives in supercomputing,1 petaflop and beyond extrapolates to 40 kW - 60 kW per rack or 1100 watts per square foot
- Data center energy use has the attention of Washington, DC

  EPA recently issued their report to Congress on the topic of data center energy consumption – EPA Energy Star Program

DC Fundamentals

- Direct current is a synonym for constant or “constant polarity”
- It is transmitted through the use of a (+) wire a (–) wire
- It can be grounded
- It can be produced with the use of a rectifier, AC/DC
- It is a very common way to power electronic devices, and is the basic building block for energy storage, renewable energy devices
- “Oring” of feeds can be simply achieved through the use of diodes
- It typically can be distributed with less copper than AC when utilized at the proper voltages
- It is used in many industries today, rail, manufacturing, mining, aerospace, telecommunications

Why DC Makes Sense for the Data Center

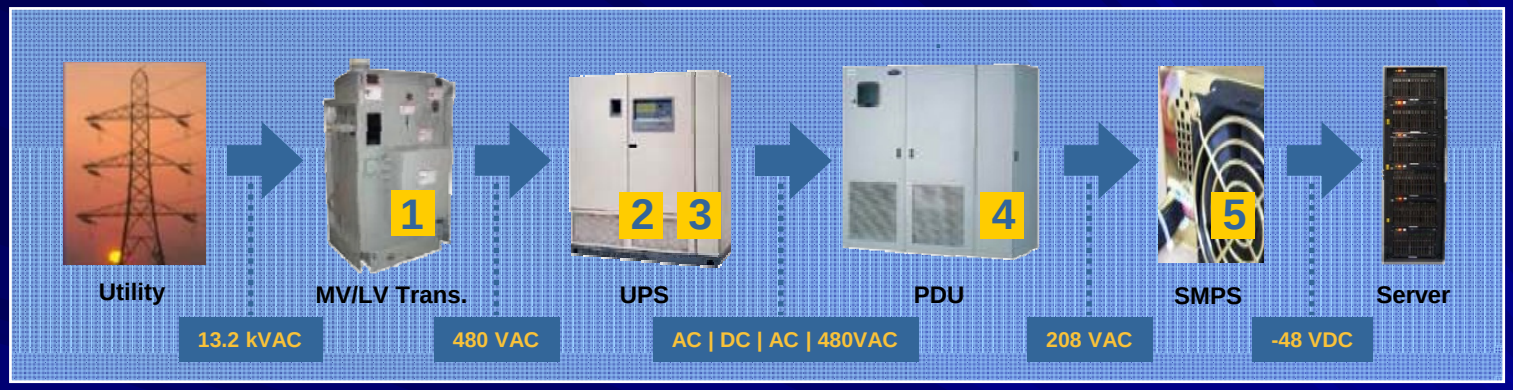
- Most of the loads are DC in nature or can be fed with DC directly
  - Servers, storage devices, motor drives and lighting
  - Simplified distribution system results in greater reliability
- Providing DC devices with DC power reduces system losses
  - Reduces the quantity of power conversions and transformations before the load
  - No SMPS, reduces conversion and operational losses (HEAT)
- A -575 to -54 VDC systems combines the best of the AC & DC worlds
  - Run higher voltage (> 5KV) AC power closer to loads
  - Convert AC power to -575 VDC
  - Convert -575 VDC to -54 VDC at server row level
  - Distribute -54 VDC power in a manner similar to a Telco facility
- Aggregation and optimization of central power supplies provides:
  - Higher efficiency, reliability and maintainability
  - Reduced electrical infrastructure
  - Scalable and modular power & cooling solutions

The Benefits of DC Distribution

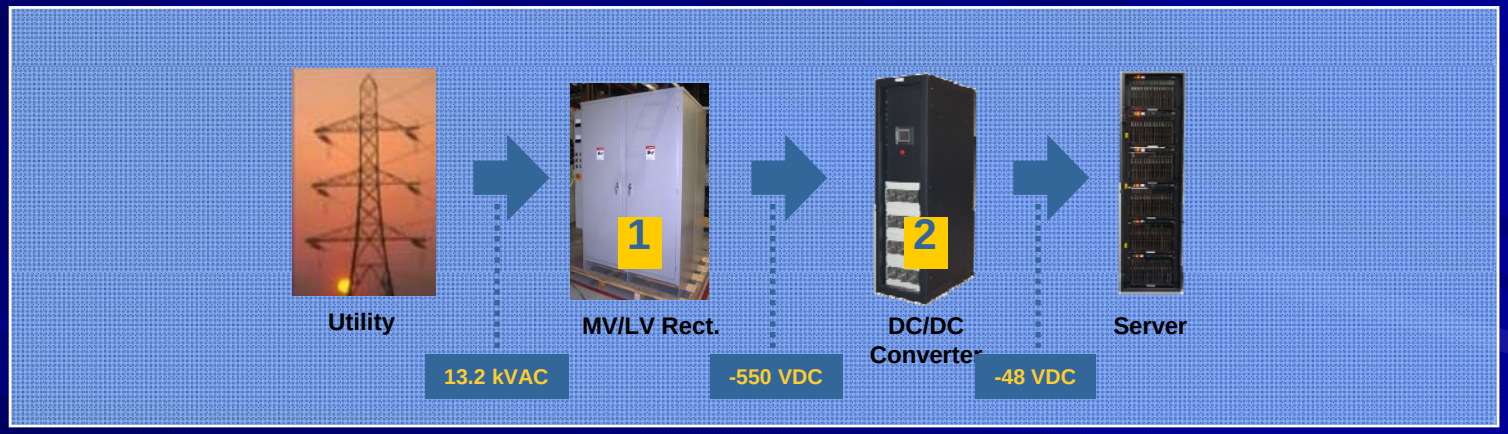
- Less copper required due to lower distribution losses
- Simplified system results in improved reliability, maintainability
- Ability to tie in (or-gate) many types of DC storage without complex electronics
    - Batteries, Fuel Cells, PVs, Flywheel, Wind Turbines
- Allows the use of highly efficient, -575 to -54 V DC-DC converters close to the load
- Allows the use of optimized high efficiency, DC power supplies in servers and other equipment
- Allows the use of more efficient DC motors and lighting

AC and DC Power Paths

Typical AC Power Path (5 Electrical Conversions) 43 to 72% Overall Efficiency

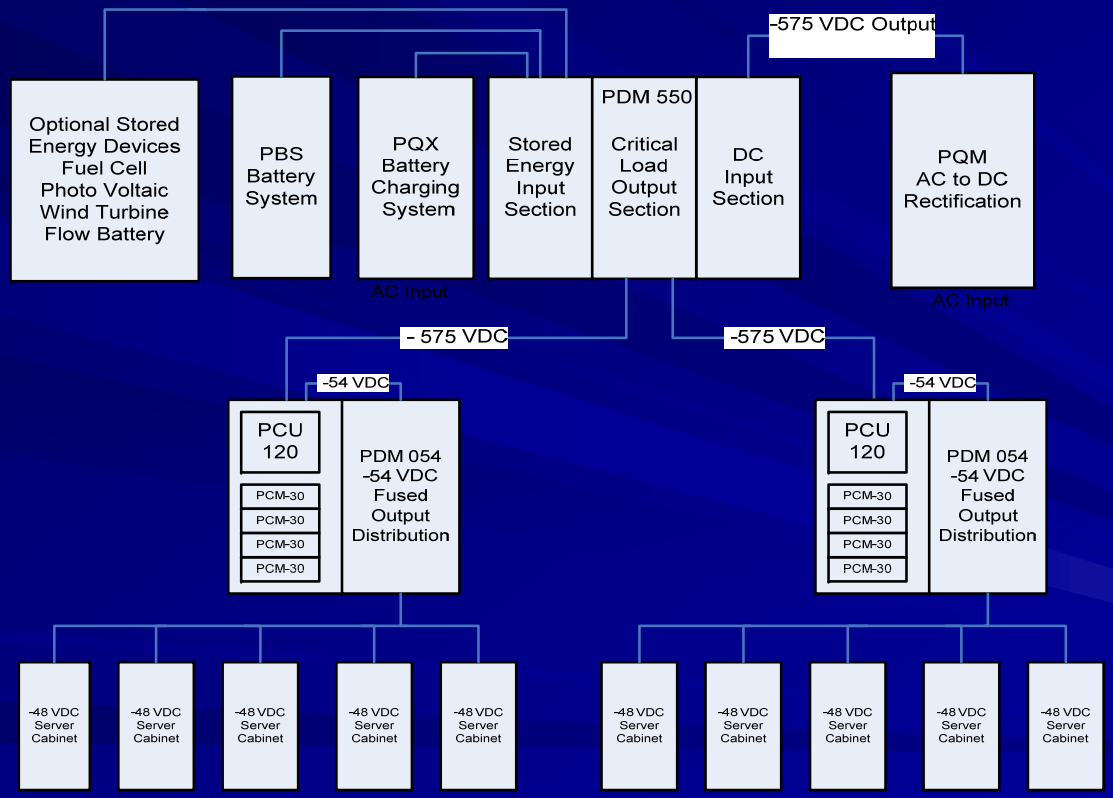


Optimized DC Power Path (2 Conversions) *83 to 88% Overall Efficiency*

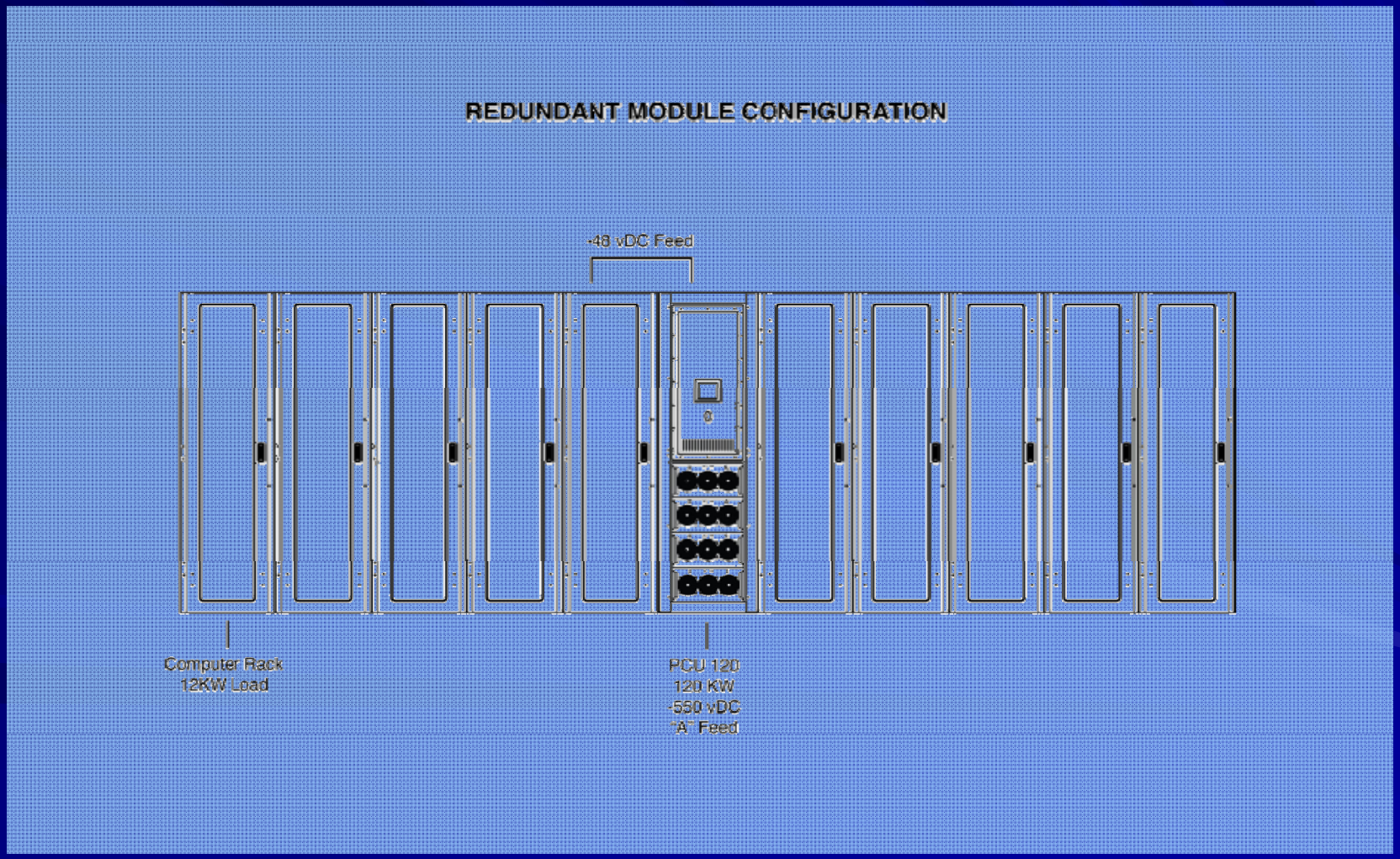


Lower efficiency affects not only the power required for the IT equipment, it also affects the amount of cooling required to account for heat gain within the facility

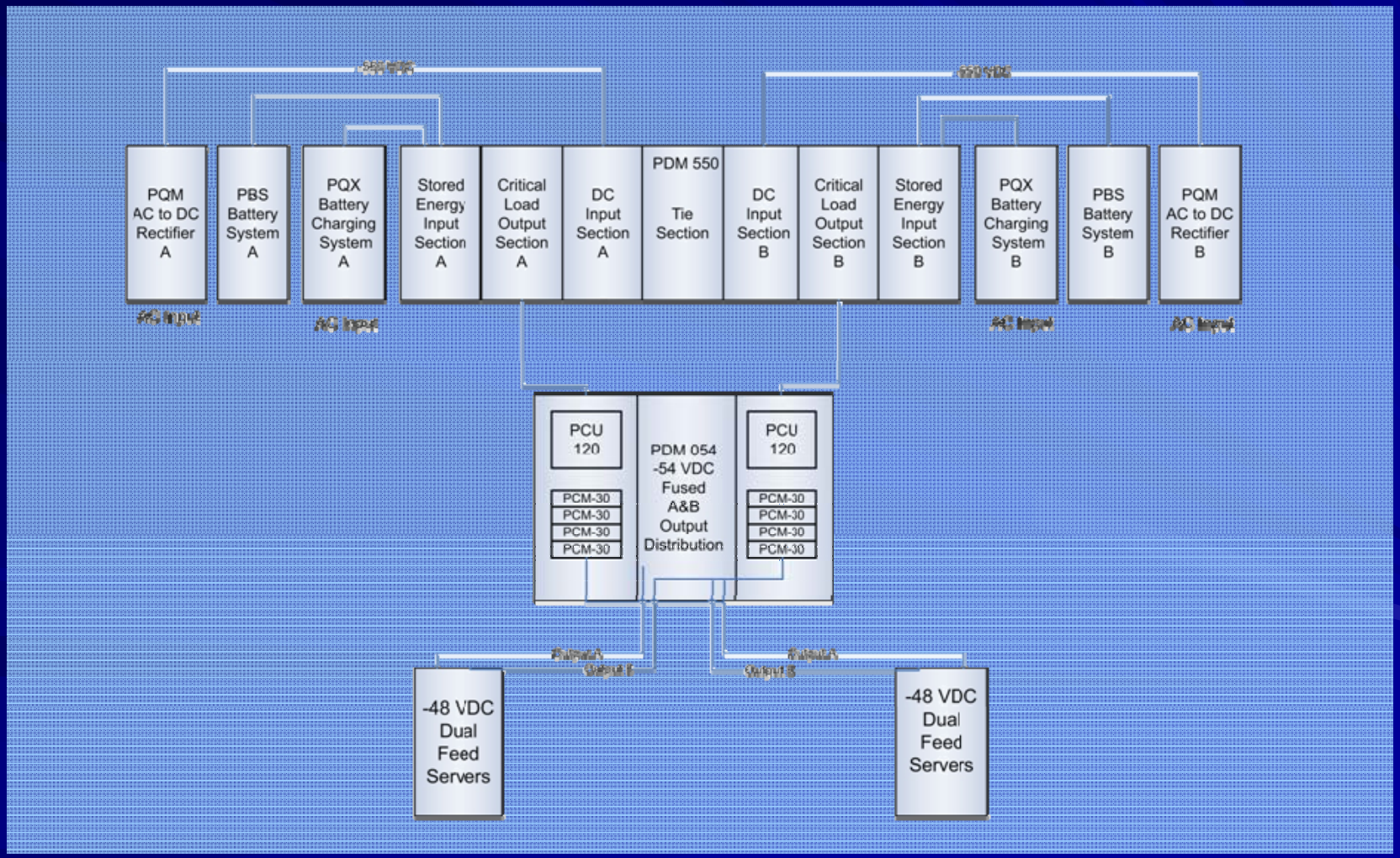
N, N+1 -575 VDC System Arrangement



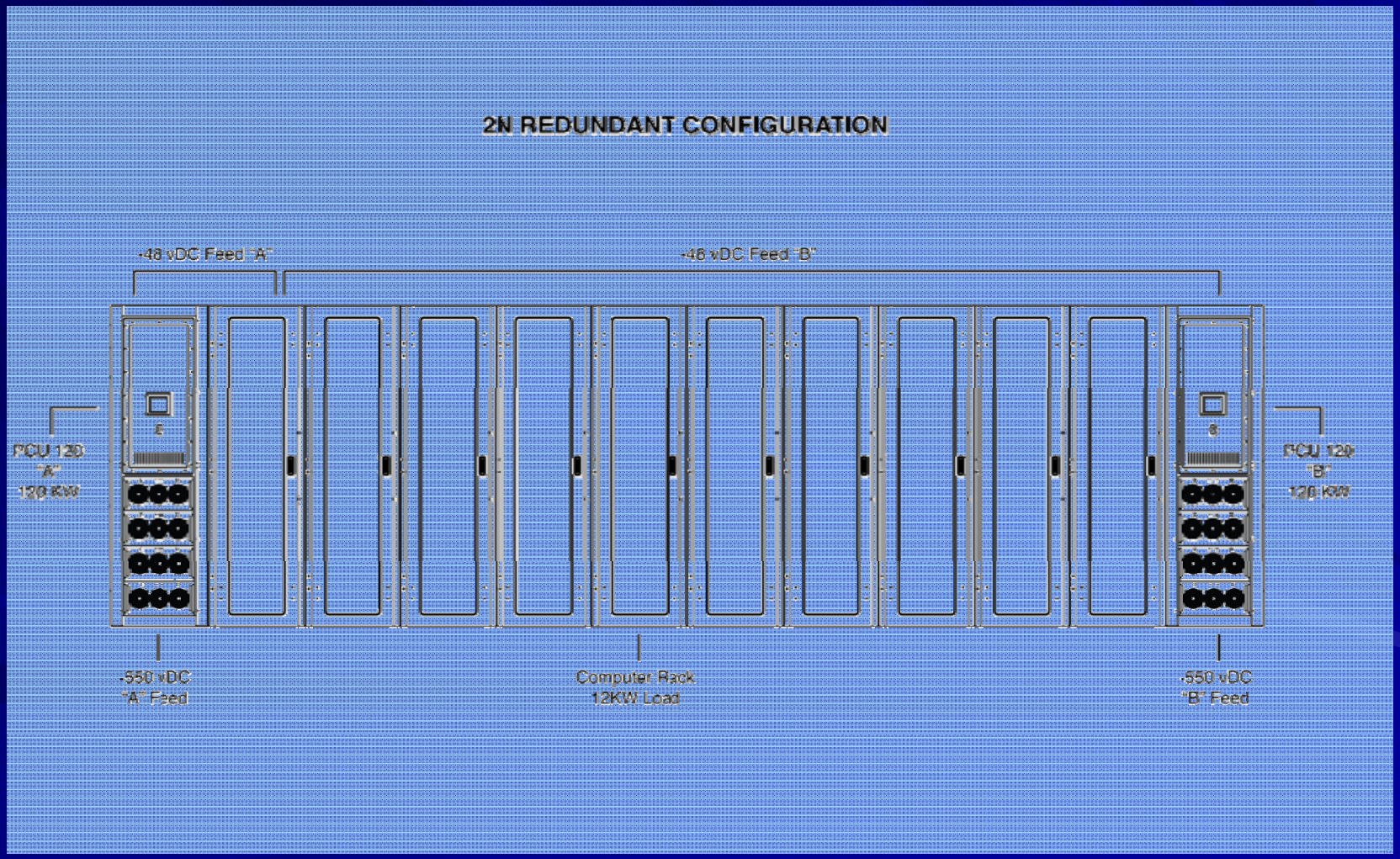
N, N+1 Configuration



2N, 2N+1 -575 VDC System Arrangement



2N, 2N+1 Configuration



DC Design Considerations

- 600 and 60 VDC components are available
- Supports simple integration of alternative energy sources
- DC requires less copper than AC
- Reduced square footage requirements
- Easily provides N+1, 2N or 2(N+1) redundant designs
- Reduced cooling requirements
- Frequency, phase angle and harmonics are not issues
- Higher availability than AC systems
- Scalable, modular, efficient and universal
- Supports LEED certified designs

Q & A

PCM 030: 30kW DC-DC Power Module

- -575 VDC Input -54 VDC Output
- Compact design
- Will operate independently from other power supplies and all external controls
- Highly efficient under dynamic and low loading
- Hot swappable under full loading in redundant configuration

The Power Converter Unit (PCU 120)

- 30-120 kW in a 19” Rack
- 30kW modules
- N+1 redundant capable
- -575 VDC Input -54 VDC output
- Hot swappable modules
- Dual feed capable
- Customizable controls and monitoring
- TUV approved to UL/IEC and FCC standards