



GE Energy Storage Inverter Capability Overview

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[Imagination at work.](#)

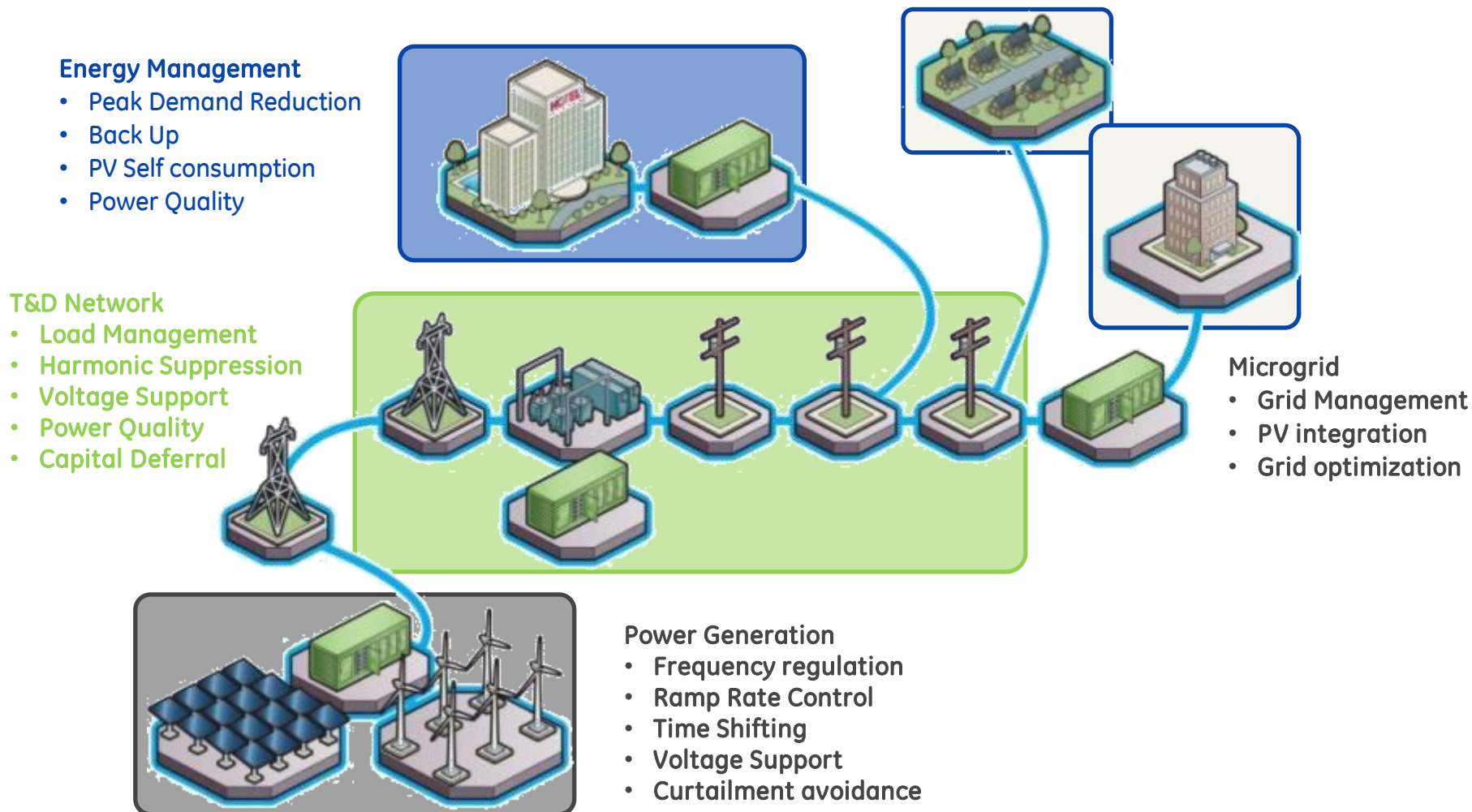
GE Energy Storage

Division of GE Renewable Power within GE Power and Water
HQ in Schenectady New York –Sales and Service worldwide
Active in energy storage for 10+ years
~50 MWH in operation or construction around the world
System integrator providing End to End ES systems worldwide



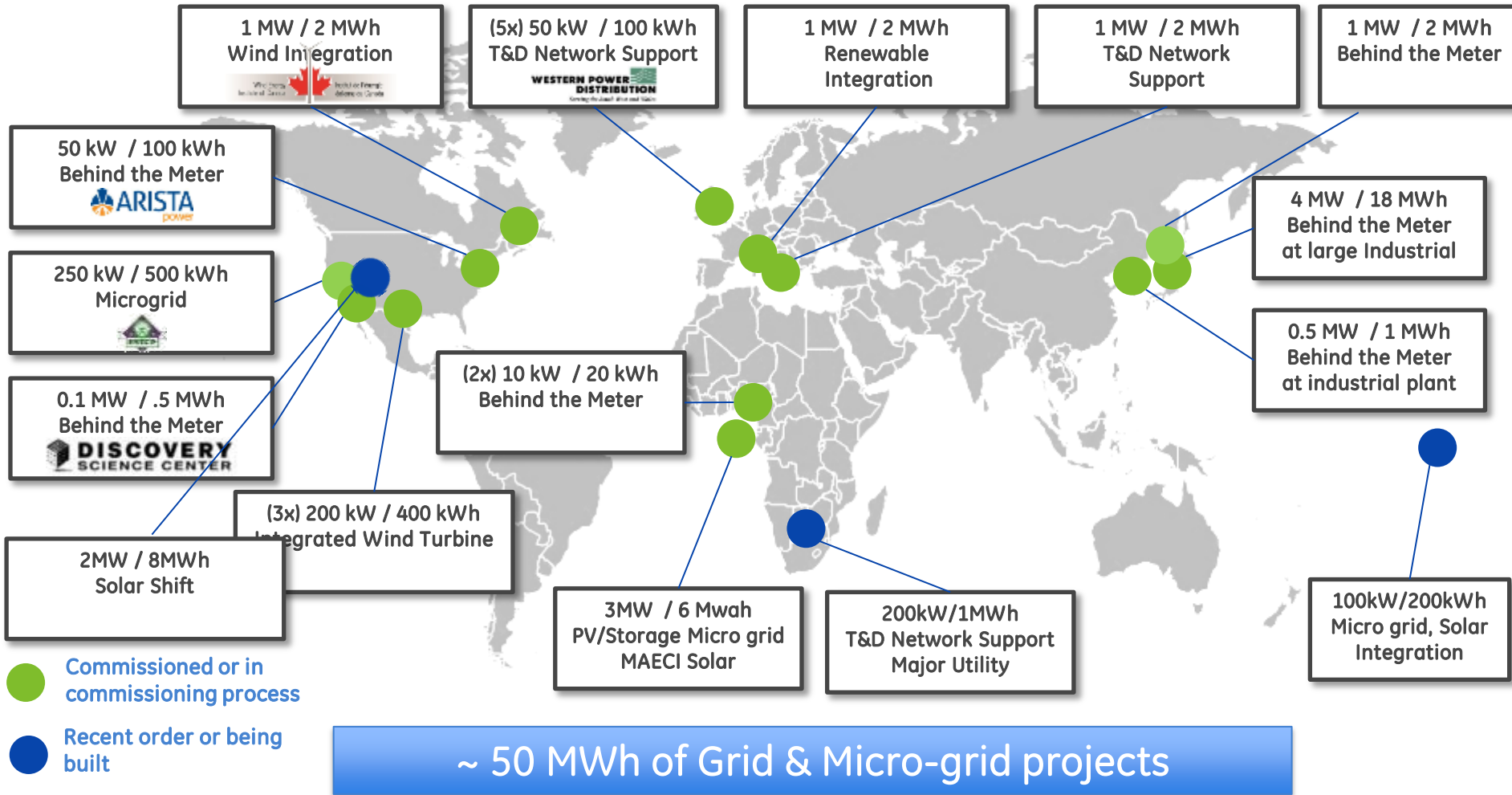
Focusing on 4 Grid Segments

Providing key applications combined with power and energy performance



GE Energy Grid Projects

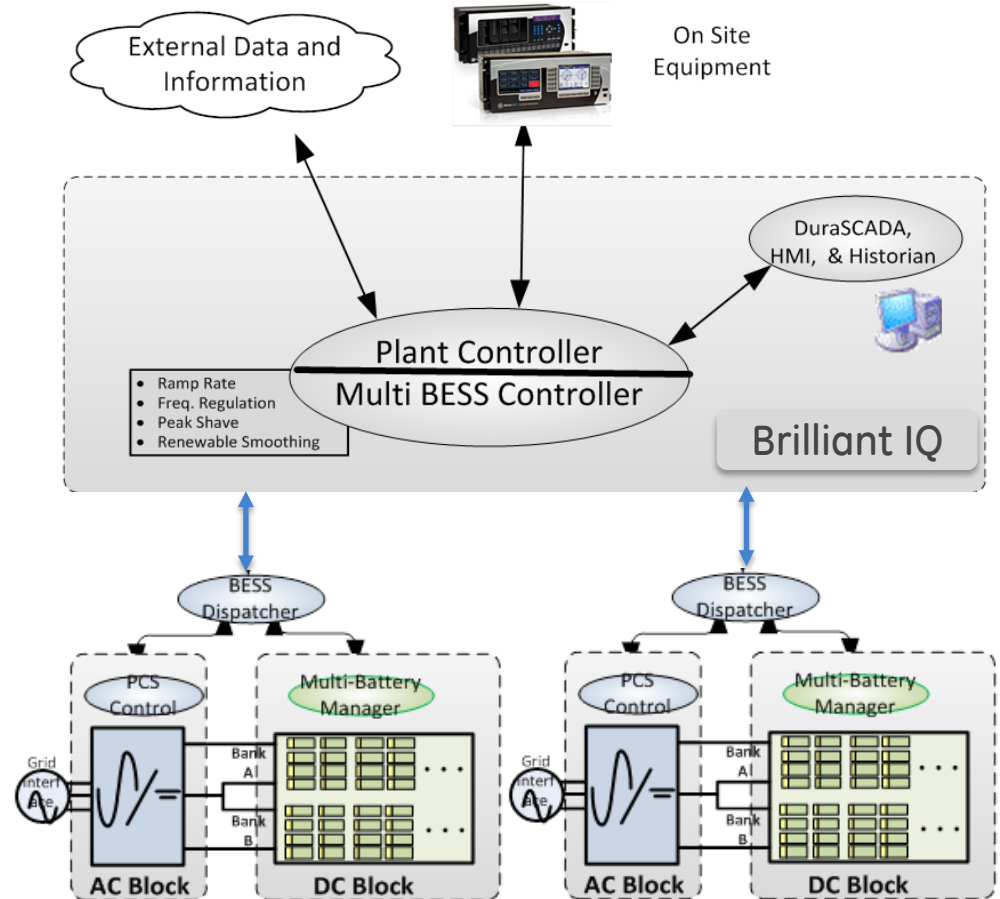
Expanding Global Presence and Grid Applications



Leveraging GE Expertise

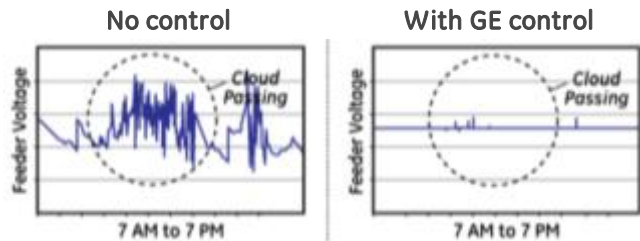
Storage Plant is comprised of Key GE offerings

- **Controls** – GE is a world leader in control systems for grid connected systems with years of experience in Generation, T&D, and large scale industrial systems
- **AC Hardware** – GE has a proud history of supplying AC hardware including inverter, transformer and High and Med voltage equipment to global utility and Industrial customers
- **DC Block** – As a battery manufacturer we have deep technical understanding of key battery design and safety elements such as cell design, thermal management



GE Brilliance IQ Plant Controls & SCADA

Voltage Regulation - example



Robust plant level control

- Integrated Ramp Rate control
- Power frequency response
- Voltage regulation
- Integrated PF/VAR control
- Power curtailment
- Plant shut-down/start-up



Integrated SCADA

- Real-time data visualization
- Remote Monitoring and Operation
- Substation & Weather station I/O
- High Speed Data capture
- Historical data analysis
- Automated reporting

Based on GE Mark VIe controls platform

- Heart of GE's wind & thermal power plant fleet
- 250+ utility scale projects controlled
- 100+ GW renewables feasibility studies
- 40+ grid integration patents



GE's proven grid integration expertise



GE Brilliance Inverter

GE's Brilliance™ Inverter is the latest evolution of GE's proven power conversion technology for grid-tie, energy storage applications. There are over 23,000 installs of the Brilliance platform on GE Wind turbines

Inverter Features:

- 1.25 MVA 50/60Hz options
- Peak Conversion Efficiency >97.5%
- Power Factor Range +/- 0.93 / Noise < 80dBA
- Integrated 3000 A dc disconnect & 2000 A ac circuit breaker,
- NEMA 3R outdoor construction with Integral ground fault detector / interrupter
- Full to derated Power output 40/50/55°C ambient 1.25/1.00/.650MVA
- Liquid-cooled & forced ventilated with externally replaceable air filters
- Anti-condensation heaters, internally powered and automatically controlled
- GE's Ride-Thru Technology providing LVRT, ZVRT and HVRT capability
- Targeted 100ms full power charge to discharge with < +/- 1% Voltage flicker at PCC



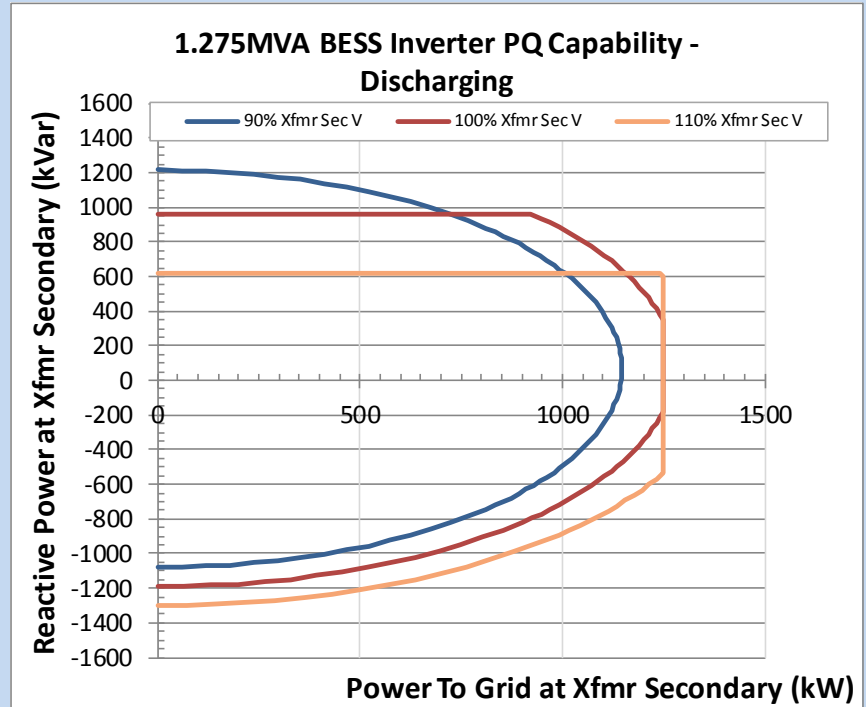
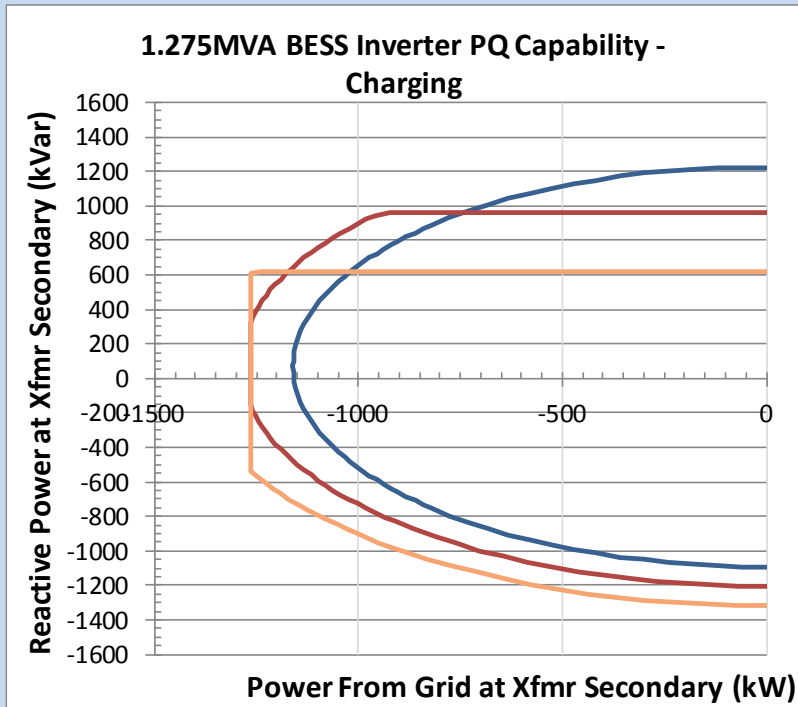
Codes Standards and Regulations Compliance

Power Conversion Equipment Safety	UL508C
Inverter, Converter, Controller & Interconnection System Safety	UL1741
Environmental Considerations for Electrical Equipment Enclosures	UL50E / CSA 22.2 NO. 94.2
Industrial Control Equipment Safety	CSA 22.2 NO. 14
Construction & Test of Rectifying Equipment	CSA 22.2 NO. 107-1
Harmonic Control	IEEE 519
Interconnection of Distributed Resources with Electric Power Systems	IEEE 1547
Seismic Tolerance	IBC / UBC Zone 4
Shock & Sinusoidal Vibration	IEC 60721-3-3 Class 3M3
EU Conformity	CE Mark



Capability Curve - Single Inverter

GE Brilliance 1.25MVA Capability Curves



Polarity convention:

Power > 0 = Power to grid (discharging)

Power < 0 = Power to battery (charging)

Q > 0 = Inverter supplies vars to grid; capacitive PF

Q < 0 = Inverter consumes vars from grid; inductive PF

Caveats:

No derating applied. Results are valid up to 1000m, 40 degC.

Internal losses not modeled. Assume -3% error when discharging, +3%

error when charging

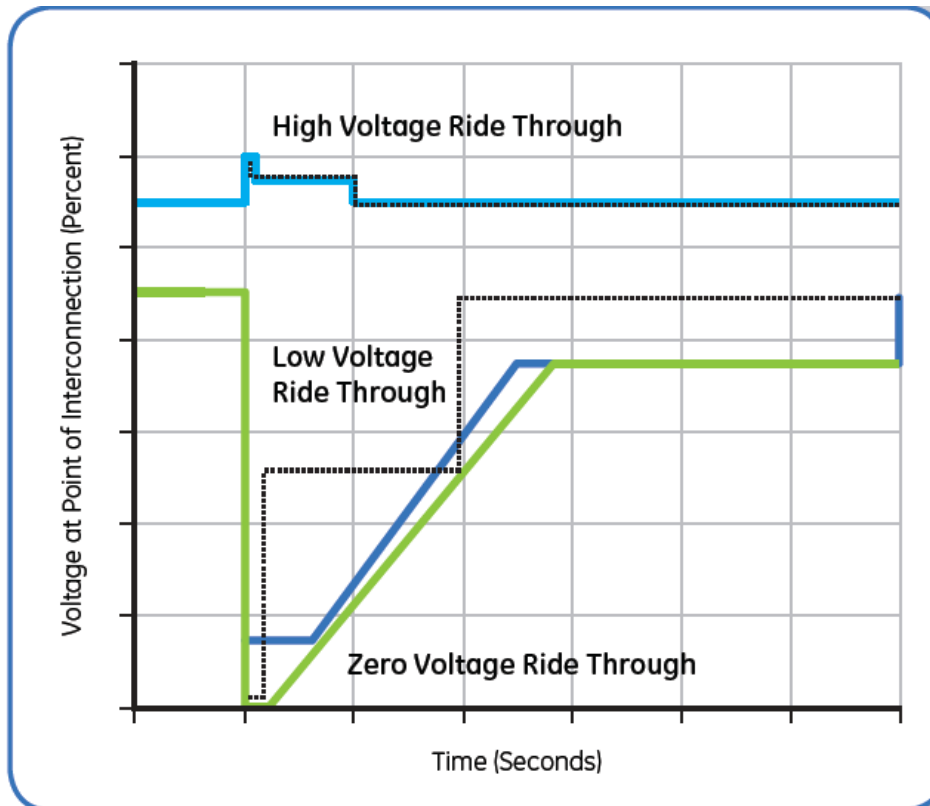
Subject to Change



RIDE-Thru Technology

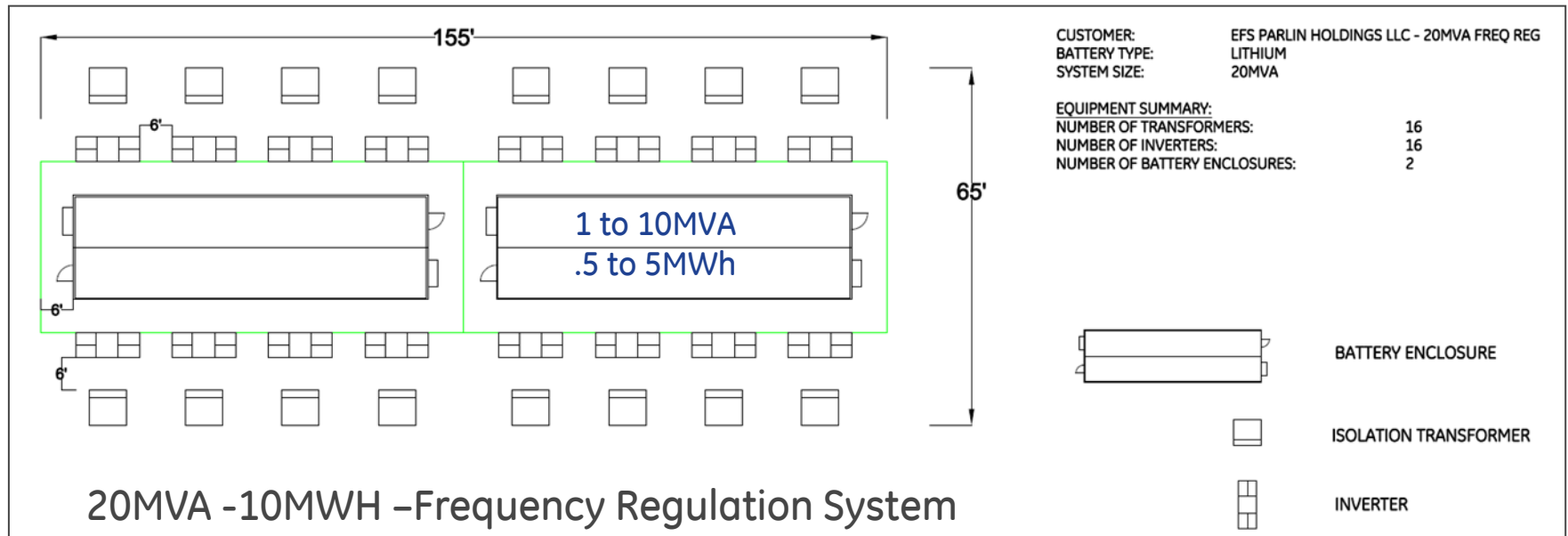
High Voltage, Low Voltage and Zero Voltage

- GE's innovative RIDE-THRU™ technology offers ride-through capability for zero-voltage (ZVRT), Low Voltage (LVRT), and High Voltage (HVRT) applications.
- The ZVRT ride-through capability conforms to U.S. Federal Energy Regulatory Commission (FERC) requirements.



System Design Considerations

PCC Power and Energy requirements
Drives inverter and storage quantity
Affects cost and performance





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