QUANTA TECHNOLOGY

DATA CENTERS

COMPREHENSIVE ENERGY AND INFRASTRUCTURE SOLUTIONS

INDEPENDENT, OBJECTIVE, AND PRACTICAL EXPERTISE IN ELECTRIC POWER

OUR SOLUTIONS

HOW WE CAN HELP

We facilitate collaboration between utilities and data centers. Our approach enables the interconnection of strategically important data center customers while managing the reliability and cost impacts for utilities and consumers. Our end-to-end solutions provide value to our clients by reducing risks and costs, and accelerating timelines.

Point of interconnection

Utility's requirements:

- **Facility interconnection requirements** (FAC standards) targeted towards end-use customers
  - Customer data forms
- **Power quality** (harmonics, voltage fluctuations, flicker)
- **Transient stability** (voltage recovery, frequency)
- **Small signal stability** (forced oscillations at low frequencies)
- **Resonance stability**
- **Others** (ramping rate, ride through requirements)

Our experience:

- **Interconnection strategy, screening/ fatal flaw studies**
- **Technology selection** (behind or front of POI)
- **Developing/testing/validating interconnection requirements**
- **System studies and impact assessments** (reliability, steady state and dynamics)
- **Facility, equipment and design**
- **Testing, integration, and validation**
- **Interconnection queue management**
- **Project management**
- **Data center tariff review**
- **Co-location design, technical studies and strategy**

Data centers requirements:

- **Reliability (enhance uptime)** – achieve 99.999% reliability, availability, maintainability (RAM)
  - Now consider upstream grid events
- **Power quality** (voltage fluctuations, harmonics not affect their equipment) – ITIC curve
- **FLISR** (fault location and isolation)
- **Supply chain** (high-quality backup) – multiple vendors
- **Others** (efficiency of DC system, microgrid controllers)

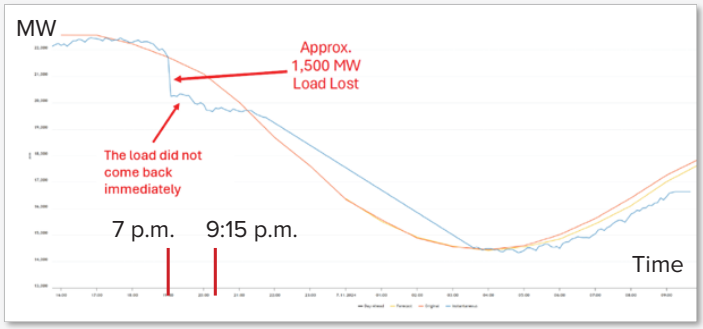
Data center load profiles and behavior

Key Success Factors

- **Effective coordination:** Establishing strong collaboration between utilities and data centers to facilitate interconnections, addressing both technology solutions and performance requirements.
- **Optimized technology selection:** Carefully selecting, configuring, and testing of data center technologies to enhance cost-efficiency and reliability.
- **Comprehensive modeling:** Developing accurate models of complex and dynamic loads to improve grid reliability and prevent overly conservative requirements from utilities during interconnection.

Challenges of Modeling Dynamic Loads:

- **Risk to utility systems:** Unexpected load behavior can jeopardize utility systems if not properly accounted for.
- **Inadequate load models:** Lack of accurate models can result in overly conservative interconnection requirements, hindering efficient operations.
- **Impact on grid reliability:** The size of data center load clusters can significantly influence overall grid stability



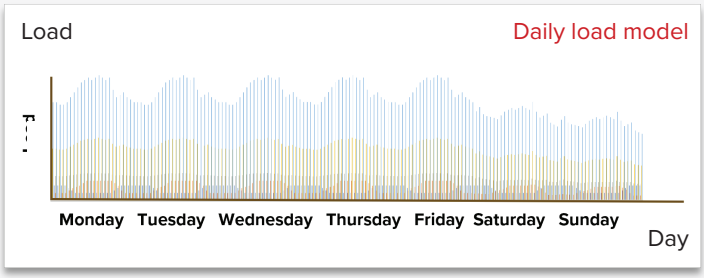
Source: NERC Incident Review 1/8/2025

Example from figure above: **1,500 MW of data center load tripped** following 230 kV faults.

Load return delays: Caused by data center uninterruptible power supply (UPS) equipment, these delays were unanticipated by system operators and require proactive solutions.

Equipment and System Testing

- **Stringent requirements:** High reliability and power quality standards for data center power delivery necessitate advanced control systems and redundancy configurations.
- **Behind-the-Meter technology I**ntegration: Effective program management services for implementing co-located generation, microgrids, and energy storage systems can mitigate supply chain risks and optimize interconnection costs.
- **Laboratory testing:** Validating the performance of advanced control and protection systems through rigorous laboratory testing before site commissioning to ensure reliability and efficiency.



SELECT USE CASES

SCOPE

Evaluate the impact of data center growth on nationwide power systems, considering state and local interconnection requirements.

Challenge

Interconnection requirements vary across the U.S. based on state and interconnecting region. A hyperscale client was seeking to evaluate locations in multiple regions (PJM, SERC, MISO ,SPP, WECC, and ERCOT) to evaluate a portfolio of potential sites across the US.

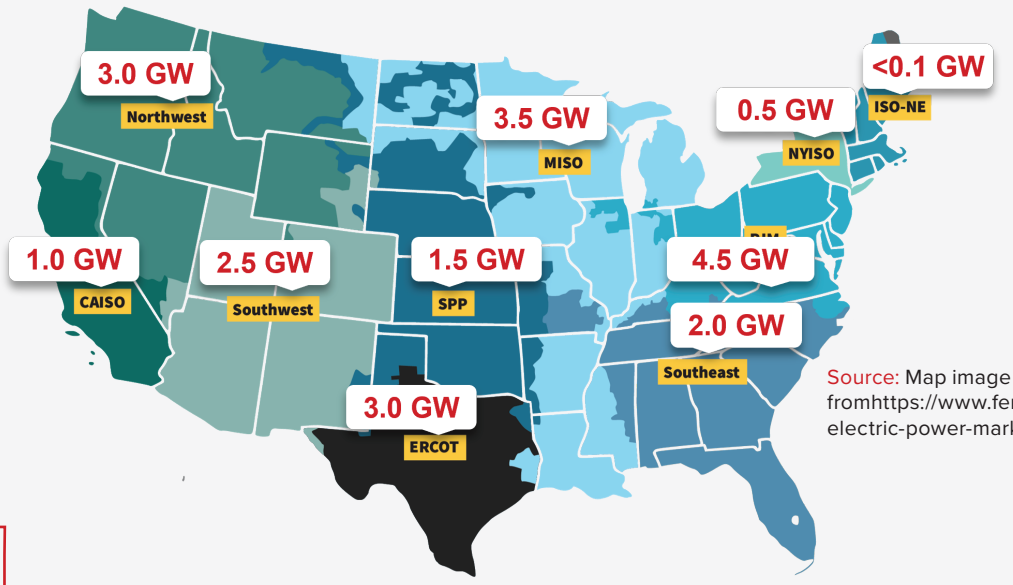
Approach

Developed updated power flow models to be used in analysis that will quantify the impact of data center.

Results

- **Delivered** heatmap representations conveying the suitability for data center interconnection by interconnection point as a GIS mapping (KMZ format) for each region and zone of the U.S.
- **Developed** transmission system models consistent with local utility practices and ISO guidelines, supplemented with public intelligence on future system conditions.
- **Conducted** contingency analysis (thermal/voltage limits) throughout individual zones, based on utility and ISO practices.
- **Identified** the interconnection limits and high-level estimates for overall network upgrade costs to interconnect data center load blocks.

More than 21 GW data centers development support 2021-2024 origination



Source: Map image fromhttps://www.ferc.gov/electric-power-markets

SCOPE

Evaluate power delivery technology, applications and testing, to ensure data center's reliability and power quality.

Challenge

Data center owners seeking to manage risks in the application of advanced technology for reliable power delivery within the data center facility.

Approach

1. **Implemented a comprehensive program** beginning with risk assessments of technology and supply chain for global deployment:
   - Circuit breakers, medium-voltage switchgear, and transformers.
   - Renewable energy integration, including energy storage system, PV, and power conversion systems.
2. **Developed requirements and specifications** for key technical elements:
   - Microgrid controller, storage, and inverter.
   - Testing and commissioning requirements.
3. **Conducted laboratory testing** during conceptual design and pre-commissioning for thorough performance validation.
   - Developed and implemented digital substations for advanced feeder redundancy automation.
   - Performed pre-commissioning tests of protection and controls.

Results

- **Meet stringent reliability requirements:** designed systems to meet rigorous standards for reliability, ensuring continuous and uninterrupted power supply.
- **Deliver clean and reliable power:** ensured the provision of sustainable and dependable energy to a large data center facility.
- **Design modular and scalable systems:** developed designs that are both modular and scalable, allowing for rapid, efficient, and global deployment.

NOT YOUR TRADITIONAL CONSULTANTS

INDEPENDENT — OBJECTIVE — PRACTICAL — EXPERTISE

Who:

- Trusted advisors and solution providers with global utility experience
- Industry-recognized thought leaders
- Engineers and MBAs with the ability to address business and technology strategy, as well as the most specialized issues
- Experience spanning the entire lifecycle, from planning to EPC implementation with Quanta companies, to asset management and renewal

Why:

- Independent, objective, and practical advice and solutions
- Unique business, regulatory, and technical expertise and best practice know-how
- Unique SW and HW solutions
- Staff extension requiring technical skills
- Testing, commissioning, integration, and post-installation evaluations of technologies via sustainable technology integration labs

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