Case Study of Direct Power Supply Transfer in Iceland Data Center

Overview

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Key Takeaways

The ICE03 data center in Akureyri, Iceland, demonstrates the benefits of direct power supply transfer using renewable energy and DC distribution to enhance efficiency, reliability, and sustainability.Overview of ICE03 Data Center

ICE03 is a Tier 3 data center campus located in Akureyri, North Iceland, covering 4.3 hectares and designed for high-density workloads. The facility leverages Iceland's cold climate for natural cooling and abundant geothermal and hydroelectric energy to provide a low-carbon, renewable power supply . Its infrastructure supports scalable operations, robust connectivity, and low-latency access to major interconnection hubs, making it suitable for AI, cloud, and high-performance computing workloads .

Direct Power Supply Transfer and DC Distribution

Traditionally, data centers rely on alternating current (AC), which requires multiple conversions to direct current (DC) for IT equipment, causing energy losses and additional hardware requirements. ICE03 and similar modern facilities are increasingly adopting direct-to-DC power distribution, which delivers DC power directly to servers and storage systems, minimizing conversion losses . Key advantages include:

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• Energy Efficiency: Reduces conversion losses by up to 20%, lowering operational costs and CO_2 emissions .

• Simplified Infrastructure: Fewer conversion stages reduce cabling complexity and maintenance requirements .

• Enhanced Reliability: DC systems provide a more stable power supply, improving uptime and fault tolerance .

• Integration with Renewable Energy: DC networks allow direct connection to battery storage systems, supporting grid stabilization, load peak capping, and renewable energy integration without additional AC/DC conversions .

Implementation in Iceland

ICE03 utilizes renewable energy sources for its DC-powered infrastructure, taking advantage of Iceland's geothermal and hydroelectric resources. The facility's design incorporates:

• Natural cooling from ambient temperatures below 5°C for several months, reducing the need for mechanical cooling .

• Battery storage integration to balance intermittent renewable generation and provide backup power .

• Direct-to-rack DC distribution to minimize conversion stages, similar to approaches used by leading global operators . This combination of DC power distribution and renewable energy enables ICE03 to achieve high energy efficiency, low PUE, and sustainable operations, aligning with Iceland's national goals for low-carbon infrastructure .

Outcomes and Benefits

The direct power supply transfer approach at ICE03 results in:

• Reduced energy consumption and operational costs due to minimized AC/DC conversions .

• Lower carbon footprint, supporting net-zero emission goals .

• Scalable and reliable operations, capable of handling high-density workloads and future expansion .

• Enhanced integration with renewable energy and battery storage, improving grid stability and resilience .

Conclusion

The ICE03 data center in Iceland serves as a practical case study for implementing direct power supply transfer in a renewable-energy-powered environment. By combining DC distribution, natural cooling, and battery integration, the facility demonstrates how energy efficiency, sustainability, and operational reliability can be achieved simultaneously in modern data centers .

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