

How to Improve Grid Connection: VDE Briefing on Peak Load Management for High-Performance Data Centers

While billions are being invested worldwide in high-performance data centers for AI, connecting these facilities to the grid is becoming increasingly problematic. The latest briefing from VDE ITG and VDE ETG outlines what is needed to enable grid connection despite peak loads.

(Frankfurt am Main, July 16, 2026) Artificial intelligence (AI) applications are being used on a massive scale, and so far there is no end in sight to this trend. High-performance data centers—known as AI data centers (AI-DCs)—are necessary to keep pace with this global trend and remain economically competitive. However, expanding electrical grids to support these data centers is expensive, and the demands on grid stability and resilience are growing—not least because the load profiles during training, on the one hand, and during inference (i.e., the application of trained models), on the other, differ significantly from one another.

“These differences require an analysis of energy and power demand during transient energy consumption so that mechanisms can then be applied to efficiently balance out load peaks,” explains Damian Dudek, Managing Director of the Information Technology Society within VDE (VDE ITG) and co-author of a recent brief on the topic.

The brief, published jointly by the VDE ITG and the Power Engineering Society within VDE (VDE ETG), outlines concrete solutions for managing fluctuations in energy consumption.

“Conventional power distribution systems, based on 48V voltage, are reaching their limits when dealing with the high power levels of modern AI-DC racks,” explains Prof. Dr.-Ing. Gerd Griepentrog from the Department of Power Electronics and Drive Control at TU Darmstadt, one of the co-authors. “The switch to an 800V DC distribution system significantly reduces power losses and copper requirements.” A key component in this approach is DC/DC converters, which step down the voltage from 800V to 48V, thereby ensuring compatibility with existing

systems. “Currently, these converters achieve an efficiency of up to 98 percent and deliver a precise 48V output voltage,” Griepentrog continues. “Researchers are working to reduce the number of conversion stages to further increase efficiency.”

To compensate for load peaks, ITG and ETG also propose a multi-stage storage architecture to enable flexible responses across different time scales. Numerous data center operators are already relying on this multi-stage architecture, which combines battery storage with UPS systems. “The specific design depends on the location, usage requirements for training or inference, and the specifications of the grid operators,” says Dudek.

Standardization as the Key to Greater Efficiency

“The grid connection for these data centers poses a significant challenge due to regulatory conditions and the availability of electrical energy and grid connection capacity, especially in metropolitan areas,” summarizes Prof. Dr. Andreas Ulbig, Professor of Active Energy Distribution Networks at the IAEW at RWTH Aachen University and at the Fraunhofer FIT Center for Digital Energy, a member of the VDE ETG Executive Board, and also a co-author of the paper.

The authors see standardization as a key to greater efficiency. To date, AI-DCs have used different voltage levels. “A standardization process would be helpful here—for example, to optimize the sizing of compensation devices, open up the market for these technologies, and accelerate the integration of renewable energy,” says VDE ITG Managing Director Damian Dudek.

The VDE ITG and VDE ETG brief “Intelligent Peak Load Management in High-Performance Data Centers” can be downloaded [here](#).

About the Information Technology Society within VDE (VDE ITG)

The Information Technology Society within VDE (VDE ITG) is a community of experts working in the field of information and communication technology (ICT). Founded in 1954, this technical society aims to pave the way for innovative technology topics, bringing them from the scientific world into our economy and society. It combines theory and practice to promote the technology topics of tomorrow, which are crucial for the digital transformation of the economy and society. The ITG sees itself as a driving force in the ICT field and supports the VDE vision of a livable and e-dialistic future.

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About the Power Engineering Society within VDE (VDE ETG)

The Power Engineering Society within VDE (VDE ETG) promotes the development of energy systems in Germany. It combines expertise in the generation, storage, transmission and distribution of electrical energy and the relevant interdisciplinary technologies, as well as the many different ways in which this energy is used. Integrated into the VDE interdisciplinary network, ETG is a widely recognized and respected technical and scientific association. The volunteer experts create a common platform for knowledge exchange in science and industry, contribute to accelerating the energy transition and to promoting an understanding of sustainable energy technology in society, and identify areas of action for policymakers. ETG connects people, different generations, start-ups and established institutions, science, business and society with performance and energy.

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The VDE (VDE Association for Electrical, Electronic & Information Technologies) is headquartered in Frankfurt am Main. For more information, visit www.vde.com

Press contact: Vanessa Rothe, Phone +49 69 6308-292, presse@vde.com