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Application of Modular Multilevel Converters in Electric Arc Furnace Systems

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Electric arc furnaces (EAF) play a pivotal role in the steel industry's transition toward renewable energy and reduced emissions. However, their grid-disturbing behavior makes it increasingly challenging to integrate new systems into weak grids.
To meet these demands, Primetals Technologies has developed the Active Power Feeder (APF) based on Modular Multilevel Converters (MMC) technology. MMCs are widely used in HVDC and other high-performance applications thanks to their modular and scalable design, multilevel voltage output, inherent redundancy, high efficiency, reduced necessity of passive filters, and fault-ride-through capability. For EAF operation, these advantages can be used to full capacity.
First, grid stabilization is essential. The APF enables active power control for EAF operation while compensating other furnaces by injecting reactive power to stabilize grid voltage and frequency.
Second, process optimization ensures the most efficient melting procedure. Acting as an electric actuator, the APF provides precise, high-bandwidth control of arc currents and voltages - superior to slower mechanical actuators. By limiting current spikes, it reduces material wear. Rapid voltage adjustment prevents arc loss and eliminates the need for on-load tap changers at the transformer.

This publication will include information and technical data from the first installed APF-system, used for production at an industrial steel plant (It is intended to provide name and location of the steel plant. However, this needs to be requested according to data protection). Beside the metallurgical and process optimizations, electrical characteristics will also be explained. The new degrees of freedom for control of the EAF like frequency, overcurrent protection, dynamic and unsymmetric operation and several others are part of the investigations done in the oral presentation/paper.
Additionally, a technical view on the used hardware components is planned. This includes power electronic modules, passive components (reactors), cooling strategy and an overall explanation of the circuit.

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