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Evolving AC electric steelmaking –from thyristor based digital power supply solutions to the next generation advanced furnace power control system

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Electric steelmaking is undergoing a significant technological transformation propelled by innovations in power electronics, automation, and digitalization. This paper presents a comprehensive evaluation of two generations of digital power supply technologies for AC electric arc furnaces (EAF), highlighting the successful implementation of advanced control systems that drive productivity, optimize energy consumption, and elevate operational safety.

A decade ago, ABB commissioned a first-generation digital AC EAF utilizing Hatch's SPLC technology. Long-term operational data reveal advantages in several areas including gains in production, reduced electrical and electrode consumption, and enhanced process stability through independent arc voltage and arc current control. These improvements have contributed to more sustainable steelmaking practices and lower operational costs.

Recognizing the need for superior power quality, the next generation of digital power supply system was developed. This innovative solution combines precise furnace power management with advanced power quality enhancement, including active power control, reactive power compensation, flicker reduction, and harmonic mitigation for furnaces connected to medium and high voltage grids. The unified series and shunt control architecture delivers robust arc stability, increased productivity and grid-friendly performance, supporting seamless integration with renewable energy sources and facilitating decarbonization efforts within the steel industry.

Comparative analysis of field data demonstrates the effectiveness of these power electronic solutions in achieving reliable, efficient, and environmentally responsible steel production. Enhanced automation and digitalization enable precise melting process control, further reducing energy usage and maintenance requirements, while improving safety by minimizing personnel exposure to hazardous conditions and supporting proactive risk management.

This work underscores the role of cutting-edge digital power supply systems in advancing electric steelmaking, aligning with industry priorities of energy efficiency, grid integration, sustainability, and workplace safety.

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