Fast and Robust Predictive Current Controller for Flicker Reduction in DC Arc Furnaces

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References:

Abstract:
A fast and robust predictive current controller for reduction of flicker caused by dc electric arc furnaces (EAFs) supplied by thyristor converters is presented in this paper. During normal EAF operation, large active and reactive power variations can occur at the point of furnace connection, causing unwanted variations of network voltage and correspondingly a flicker phenomenon. The main cause of this phenomenon are electrode short-circuits with large current swings, which occur during so-called bore-in period of the furnace cycle. The proposed controller reduces the flicker caused mainly by reactive power variations during the electrode short-circuits by providing fast and robust predictive control of the arc current without relying on the accurate arc model. The obtained simulation and experimental results demonstrate the ability of the presented current controller to effectively compensate for the electrode short circuits, thereby enabling a reduction of the unwanted fluctuations of the reactive power, which are the main cause of the induced flicker. The simulation results show that the proposed controller can reduce the induced flicker by up to 50%, compared to the traditionally used system with PI current controller. Also, the controller is robust to the asymmetries and the abrupt changes of the network voltage.

Keywords:
rectifiers, flicker, predictive control, DC electric arc furnaces, thyristors