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Research Article

# Novel Techniques for Reducing Transformer Inrush Current Using EMTP Software

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**Abstract**

Transformer inrush current is a high amplitude, non-sinusoidal current that occurs during the initial cycles after energizing the transformer. This current can lead to various issues in power systems such as voltage drops, heat losses, reduced power quality, and improper operation of protective relays. Harmonic content analysis of this current is conducted to distinguish it from fault currents, aiming to prevent improper protective system operation. However, techniques that reduce the magnitude of transformer inrush current can mitigate its detrimental effects. Therefore, this paper comprehensively studies novel techniques aimed at reducing transformer inrush current. Different magnetic materials used in transformer core construction are evaluated based on their magnetic characteristics, and the amplitude and harmonic content of the resulting inrush currents are assessed using EMTP-RV software. This evaluation facilitates the selection of suitable magnetic materials for transformer cores. Furthermore, other techniques for reducing transformer inrush current, including switching time, residual flux, and transformer loading, are investigated. Their effects on transformer inrush current are modeled using EMTP-RV software.

**Keywords:** Inrush Current, Transformer, Magnetic Characteristics, Switching Time, Residual Flux.

**Highlights**

- Performing a complete study on the effective methods used for reducing transformer inrush current.
- Comparing various magnetic materials used as transformer cores regarding the magnitude of inrush current, core loss, and costs.
- Investigating the effect of introduced techniques on reducing inrush current by conducting studies in EMTP-RV software.

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