LOAD-INJECTED DC CURRENT IN DISTRIBUTION TRANSFORMERS

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ABSTRACT

Power electronic based loads and other non-linear loads on the utility system create small amounts of DC current on top of their normal AC current. Due to heavy proliferation of such loads on the present day utility system, the net DC current accumulated at the secondary of the distribution transformer is significant. This DC-current offsets the operating point of the magnetization characteristic for the iron core, and creates a severe asymmetry between the positive and negative half cycles of the magnetization current, both in magnitude and shape, owing to magnetic saturation. It directly affects the shape of input current, and also recreates a DC current at input with magnitude even higher than that present at the secondary.

This project is about investigating the effects on primary (supply) current due to DC current in the secondary of a transformer, and eliminating such effects altogether by diverting DC current away from the secondary with a suitable power electronic controller.

Investigations were carried out by simulations, after developing a model for the magnetization characteristic for the transformer, based on test data. Simulations were carried out in MATLAB for different combinations of AC and DC current in the secondary, and the results obtained were compared and discussed against the experimental observations made on the real transformer.

DC current diversion away from the transformer secondary was done by measuring the load-demanded (or returned) DC current, and injecting (or absorbing) an equal DC current at the secondary terminals. This was a complex task because measuring a small DC current superimposed with a large AC current was not straightforward, and also injecting a small DC current accurately against a large AC voltage present across the transformer secondary was not straightforward. However, both these challenges were successfully overcome and an extremely good DC current diversion system developed. All details of the design are given and described in the report.

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