CREATION OF A BENCHMARK SAMPLE TO FACILITATE GAP ETCHING ANALYSIS OF PRE-PAYMENT METER SURGE ARRESTERS REMOVED FROM THE FIELD

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A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Engineering.

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DECLARATION

I declare that this research report is my own, unaided work. It is being submitted for the Degree of Master of Science in Engineering at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

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_____ day of ______ 2004

ABSTRACT

Comparison of the etchings on the gap plates of a gapped SiC surge arrester removed from the field - to a benchmark sample - yields a measure of the peak lightning current discharged by the arrester during its service life.

A benchmark sample for pre-payment meter surge arresters was created using the industry standard $8/20 \ \mu$ s lightning impulse waveform with peak current range: 2 to 53 kA, and a non-standard $4/70 \ \mu$ s waveform with peak current range: 0.4 to 10 kA. Using a 2nd-order lightning impulse generator, the current range per waveform was achieved by designing and constructing five resistive inductors in conjunction with three different capacitor configurations.

Analysis of the benchmark sample demonstrates gap etching area repeatability, and the existence of empirical linear relationships between gap etching area and peak current for gap etchings constrained to the central hub area of the gap plate. To my family Yvonne, Martin and Ashley

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LIST OF NOMENCLATURE

- ABC Aerial Bundle Conductor
- BIL Basic Insulation Level
- DUT Device Under Test
- EMTP Electromagnetic Transients Program
- EPRI Electric Power Research Institute
- IEC International Electrotechnical Commission
- L-N Live to Neutral
- LV Low (network) Voltage ($U_n \le 1 \text{ kV}$)
- MEN Multiple-Earthed Neutral
- MOV Metal Oxide Varistor
- MV Medium (network) Voltage (1 kV < $U_n \le 44$ kV)
- SABS South African Bureau of Standards
- SiC Silicon-Carbide
- SPE Single-Point Earth
- Trfr Transformer
- TSI Technology Services International (a subsidiary of Eskom Enterprises)
- ZnO Zinc-Oxide