VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELGAUM

A PROJECT REPORT ON

PROTECTIVE RELAYING FOR POWER TRANSFORMER USING FPGA

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ABSTRACT

The reliable operation of a power transformer is of vital importance in maintaining the continuity of power supply. When transformer internal faults occur, immediate disconnection of the faulted transformer is necessary to avoid extensive damage and/or preserve power system stability and power quality. Any unscheduled outage, especially replacement of a faulty transformer, is very expensive and time consuming.

Power transformers are very expensive and vital components in electric power systems. They occasionally experience faults resulting from insulation failures caused by atmospheric disturbances and switching surges. These transformer faults can be divided into two main classes. The first class is internal faults due to faults to ground on terminals or on parts of windings. The second class is overload and external short circuits and reduced system frequency.

The goal of this project is to detect internal and external faults in a power transformer and protective relaying of it using standard HDL coding and simulation, to apply the differential relaying principle to detect the faults in the power transformer.

In this project a wavelet based digital directional relay for power transformer protection is implemented using a field programmable gate array. All the coding is done using the Hardware Description Language (VHDL) for developing the prototype relay. The relay logic consists of two parts: disturbance detection based on first-level high-frequency details of the voltage signals and fault discrimination using a power-based directional signal derived from the first-level high-frequency details of both voltage and current signals. The logic is deterministic, computationally efficient, fast, secure and highly reliable. The operating time is 6 ms, about one-third of power frequency cycle (20 ms). The scheme uses only the sign of the directional signals, rather than the difference in their magnitudes, hence it can work reliably in the presence of fault resistance and current transformer saturation.

As a part of the project, the disturbance detection and fault discrimination are implemented in VHDL. It is simulated and synthesized using the Mentor Graphics Cad Tools called ModelSim. The obtained simulation and synthesis results are presented.