

Study of Power Transformer Abnormalities and IT Applications in Power Systems

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(ABSTRACT)

With deregulation, diagnosis and maintenance of power equipment, especially power transformers, become increasingly important to keep power systems in reliable operation. This dissertation systematically studied two kinds of transformer failure and abnormality cases, and then developed a new Internet based Virtual Hospital (VH) for power equipment to help power equipment diagnosis and maintenance.

A practical case of generator-step-up (GSU) transformer failures in a pumped storage plant was extensively studied. Abnormal electrical phenomena associated with GSU transformers, including switching transients and very fast transients (VFT), and lightning, were analyzed. Simulation showed that circuit breaker restriking could be a major cause of transformer successive failures, and current surge arrester configuration did not provide enough lightning protection to GSU transformers. Mitigation of abnormal electrical phenomena effects on GSU transformers was proposed and discussed. The study can be a complete reference of troubleshooting of other similar transformer failures.

Geomagnetically induced current (GIC) is another possible cause of transformer abnormality. A simplified method based on the equivalent magnetizing curve for transformers with different core design was developed and validated to estimate harmonic currents and MVar drawn by power transformers with a given GIC. An effective indicator was proposed using partial harmonic distortion, *PHD*, to show when the transformer begins saturating with the input GIC. The developed method has been applied to a real time GIC monitoring system last year for a large power network with thousands of transformers.

A new Internet based Virtual Hospital (VH) for Power Equipment was conceptually developed to share experience of power equipment diagnosis and maintenance, and update the existing diagnostic techniques and maintenance strategies, and a comprehensive information model was developed for data organization, access, and archiving related to

equipment diagnosis and maintenance. An Internet based interactive fault diagnostic tool has been launched for power transformers based on dissolved gas analysis (DGA).

The above results and findings can help improving power equipment diagnosis and utility maintenance strategies.

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DEDICATED To

My lovely family

and my two-year-old daughter, Wendy Dong

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