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Investigation into high-speed thermal instability testing of synchronous turbo-generator rotors

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2017

https://hdl.handle.net/10539/24190

Narain Singh, Amesh (2017) Investigation into high-speed thermal instability testing of synchronous turbo-generator rotors, University of the Witwatersrand, <https://hdl.handle.net/10539/24190>

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Abstract

The research presented in this thesis conclusively shows that the most effective method to perform synchronous turbo-generator rotor Thermal Instability Testing is by utilising the current injection method of condition assessment. Analysis of the experiences of a local utility for well over a decade has uncovered a high number of rotors failing thermal instability testing in recent years. This trend has brought the current testing methodology into question. Two different assessment modes of testing have been found to be utilised internationally without preference, namely, current injection and friction/windage. By determining the method that is best suited to detect a thermally sensitive rotor a service provider can benefit by improved rotor reliability as well as cost saving. The evaluation is accomplished by utilising a scaled down experimental setup based on the model of a local testing facility as well as a 600 MW turbo-generator rotor. A direct thermal mapping technique has been devised utilising infrared thermography to capture the thermal distribution of the rotor surface under different test conditions. The results obtained have shown that the methods differ substantially with the friction method exhibiting a uniform surface distribution and the current-injection method exhibiting areas of higher temperature concentration around the rotor pole faces. However, weaknesses do exist in present-day testing techniques in the form of inaccurate temperature measurements during testing as well as little consideration given to external factors such as the interaction between the slip-ring and brush gear that have the potential to influence test outcomes. A presented augmented method of performing thermal sensitivity testing taking advantage of infrared thermography is found to improve testing accuracy and aid in fault detection and location. Current thermal instability testing coupled with the direct thermal mapping method has been demonstrated to be the most effective means for performing rotor thermal sensitivity testing.