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Eskom-ZESA interconnected power system modelling

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ABSTRACT

The power system frequency must be kept as close as possible to the nominal value. This is due to the inherent design of electrical equipment to operate efficiently at the nominal frequency. Frequency regulation in an interconnected power system is the duty of all members of the interconnection. However, in the Eskom-ZESA interconnected power system Eskom engineers ignore the contribution of the ZESA system to primary frequency control. This is mainly due to the prevalent assumption that the ZESA control area is small relative to the Eskom control area and its contribution to primary frequency control of the interconnected power system is negligible. This document presents a project that examines the validity of this assumption via determination of the contribution of the ZESA system to the interconnected power system's primary frequency control.

The interconnected power systems background was studied to understand the theory behind the operation of two or more interconnected power systems. System frequency disturbances deemed to be a good representation of the Eskom-ZESA interconnected power system's performance were selected and analysed to validate the current assumption. The results show that there is a significant support from ZESA during a system frequency disturbance. This proves that the existing assumption is not valid anymore.

Furthermore; the generator model that mimics the Eskom-ZESA tie-line governing behaviour was developed. Two different types of governor models were employed; firstly the IEEEG1 governor was tuned to control generator output to match the tie-line performance and then the TGOV5 governor model was used. The IEEEG1 governor model is a simplified governor representation; as a result, it is not easy to tune the parameters to match tie-line response. However, the performance is acceptable and it can be used to represent the tie-line governor response. The TGOV5 governor model is very complex as discussed in section 4.2. The model includes boiler dynamics, and this improves performance such that it is possible to tune the parameters to follow the tie-line performance as close as necessary.