

Delivering Value Through Condition Monitoring in Large Power Generation Fleets: An Eskom RT&D Perspective

Ms Ramaesela Prudence Madiba, Ms Janine Jagers, Dr Amesh Narain Singh
ESKOM Research & Innovation Centre, South Africa

Eskom is South Africa's national electricity utility and operates one of the largest and most complex power generation fleets globally. The utility has an installed generation capacity of approximately 47 GW, comprising a diversified portfolio that includes fossil-fuel, nuclear, and renewable energy power plants. This paper provides an organisational perspective on the operational and economic value realised through sustained investment in condition monitoring, led by Eskom Research, Testing and Development (RT&D), within a large power generation utility. Globally, power utilities are moving from time based maintenance to data driven, condition based approaches, enabled by advanced monitoring, predictive analytics, and centralised diagnostics, to improve reliability, manage ageing assets, and operate more efficiently under growing financial and operational constraints. Managing assets of this scale and diversity presents significant operational and maintenance challenges. RT&D, established to support the operational and strategic needs of the organisation, has been at the forefront of developing and deploying advanced condition monitoring and diagnostic systems across the generation fleet. These systems include turbo generator centre line monitoring implemented across sixteen power stations through rotor stray flux, shaft voltage and current measurement, partial discharge, and electromagnetic interference monitoring. Transformer condition monitoring is supported through acoustic emission partial discharge diagnostics, and dissolved gas analysis, complemented by a dedicated, internationally accredited oil laboratory for lubricating and transformer oil analysis. Proactive condition monitoring enabled the early identification of a developing inter turn rotor fault on a 600 MW generator exhibiting elevated vibration levels. A targeted intervention allowed the repair to be completed during a 7 day outage, enabling continued safe operation until the next planned outage. Compared to a typical 30 day outage, this avoided an estimated 76.7% of potential production value loss, corresponding to an indicative avoided production loss of approximately USD 13 million.