National Symposium on Rotor Dynamics (NSRD-2003),
December 15-17, 2003, IIT, Guwahati, India

Trends in condition monitoring and assessment of rotating machinery

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Extended Abstract

A key issue in the operating of power plants is deriving maximum financial output while staying within technical, contractual and regulatory constraints. The capital investment required in a power plant necessitates high level of plant availability to make a reasonable rate of return. Thus, the minimization of operational costs resulting from unplanned plant outages, unnecessary maintenance and under utilization of plant capacity has become an important aspect of power plant operation. This can be realized by using the most cost effective maintenance practices and can be optimized by condition monitoring, condition assessment and fault diagnosis. This paper discusses the monitoring, diagnosis and condition assessment of steam turbine generators. For steam turbine generator monitoring, those measuring points need to be provided which give a comprehensive overview of the condition of the machine. The tasks of turbine generator monitoring are speed monitoring during start up, synchronization, steady state operation and shut down; monitoring of steam temperatures and pressures as process variables; rotor position to casings; vibration, pressures, temperatures and liquid levels of oils and control fluids; electrical characteristics in the generator and auxiliary systems etc

The monitoring system provides information about the operating condition of the turbine generator. The variables required are acquired by measuring appropriate parameters. When set values are reached, alarm annunciations make the operating personnel take suitable measures to restore normal operation before a protection device responds. What measures need to be taken depends on operator experience, trend calculations, efficiency studies and detection of incipient faults. The possibility of varied abnormal operating conditions necessitates to have a modular approach for monitoring, analysis of data and diagnosis. Various modules which are in use and being developed are - vibration, thermodynamics, windage, blade vibration, condenser, bar temperature

analysis for generator, radio frequency, hydrogen leak detector, end winding vibration, torsion, turbine stress monitor etc

The modules described are functionally different, while some are more analytically oriented and thus use conventional algorithms, others are based on the knowledge and experience of experts. The conventional data processing methods are complicated and expensive for diagnostic tasks. The complex tasks are now accomplished by expert systems where correlations are no longer rigidly defined in the case of conventional programming. The underlying knowledge is made available in explicit and declarative configuration in a knowledge base. However the expert systems have not been successful on a broad scale as they do not permit manipulation of uncertain and incomplete knowledge. This has been overcome by fuzzy logic expert systems which provide a method for presentation of knowledge entailing uncertainties and for modeling uncertainties in the decision making process. However, these systems suffer from dynamic updating of knowledge base, utilization of application experience and learning acquisition, generalization etc. Artificial neural networks emulate the basic characteristics of the human brain such as massive parallelism and have the capacity to process incomplete and contradictory information, knowledge about faults can be learned by training the network of a set data such as the state variables for the normal condition and those for identified fault conditions. The application of neural networks to vibration module and fault identification in turbines and generators are demonstrated.

Condition assessment of components is a major challenge for any ongoing program of generating unit life management. A logical method of component evaluation consists of a multi-level approach where progressively more vigorous assessments are undertaken only if the component in question fails to demonstrate the desired remaining life at the lower (simpler) level of evaluation. The condition assessment methodology for HP, IP, LP, generator rotors and blades are discussed

The future trend is to have power plant networks to manage the flood of data from monitoring and diagnostic applications, processing it into information and presenting it in appropriate forms at all levels of the utility.