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ABSTRACT

**CONDITION MONITORING BASED SYSTEMATIC
MODELING OF EQUIPMENT MAINTENANCE**

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In modern industry, with the expanding of business level and capacity, the maintenance cost and workplace hazards increase dramatically. Condition monitoring based method has been adopted as a mandatory field of maintenance management that is capable to monitor the equipment's operation and determine checking points for maintenance actions to be carried out prior to the occurrence of serious failure, which results in reduced maintenance cost and improved system performance.

Stable operation of equipments is a key factor for the success of service industries. The motivation of this thesis comes from the requirements of a local company, the Companhia de Electricidade de Macau, S.A. (CEM), which was established in 1972 and has become the major supplies of electricity in Macau. Coloane Power Station A, as one of CEM's subsidiary, is equipped with an asynchronous generator, called as Turbo Compound System (TCS), that is typical equipment in power plants and is driven by exhaust gas fed turbine. The objective of this thesis is to build a predictive condition monitoring based systematic model for machinery like TCS. The thesis will study various input condition parameters including vibration, temperature, sound, light and speed.

A TCS prototype system is developed in lab environment, which utilized simulated components and constructed a prototype with the same architecture as the real system. The simulated model could be used to analyze and predicate machine's operational status. This methodology is conducted as in the following processes: Firstly, the preliminary study identifies the critical components for monitoring. Secondly, vibration data will be collected, classified and stored into database. Thirdly, vibration levels are evaluated by applying spectrum analysis to digitize the running condition of the system. The patterns are recognized and matched for the frequency grade of defects. The methodology developed and experiment results on the simulated prototype could be applied in real system.

To be able to automatic performing the data analysis and preliminary diagnosis, the thesis proposed and developed the Fault Detector Program (FDP). FDP is a vibration based signal analysis technique which evaluates vibration levels with FFT spectrum analysis to discriminate normal random variations from abnormal signatures trends. The prototype took the planetary gearbox for case studies. The experimental results demonstrated that FDP is a reliable data analysis and interpretation tool for diagnosis typical types of machines faults, such as: looseness, misalignment and unbalance. It could determine an immediate maintenance to be undertaken, or suggest next checking point.

Case study has also been conducted on the cooling system in CEM, where the shafts and bearings are revealed with high failure rate. The result showed that fatigue damage to rolling element bearings in main rotor transmission could be successfully detected. To improve the overall efficiency in operation and maintenance processes, we proposed a new working style, called sustainable operator, who is required to operate with the concern of downstream maintenance activities and fulfill some fundamental maintenance tasks. It is believed the methodology proposed in this thesis has the potential for expanded applications in other rotating machineries in various industries.