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A probabilistic model for performance evaluation of steam and water system of a thermal power plant*

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Abstract. This paper discusses performance evaluation of the steam and water system in a thermal power plant, with the help of developed probabilistic model. The system consists of six subsystems with two possible states: working and failed. Failure and repair rates for each subsystem are taken to be constant. Using a probabilistic approach, the differential equations are generated. After that, steady state probabilities are determined. Besides, availability matrix is also developed, which provide various availability levels. The performance evaluation reveals that availability figure decreases with increasing failure rates, while operational availability improves with initial increase in repair rates for different sub-systems. Based upon various availability values, performance of each subsystem is analyzed and then maintenance decisions are made for all subsystems.

Keywords: probabilistic approach, steady state, availability matrix, operational availability

1 Introduction

Performance evaluation is an activity in which the performance of a system is characterized by a set of performance parameters whose quantitative values are used to evaluating the system's availability. Performance evaluation is very important for steam and water system of thermal power plant. A thermal power plant is a complex engineering system comprising of various systems: Coal handling, Steam Generation, Cooling Water, Crushing, Ash handling, Power Generation, Feed water and Steam & water system. Amongst the several utilities, steam and water system constitutes an essential part of the power generation system of a thermal plant. According to Sharma[20], the function of a steam power plant is to convert the raw energy (chemical) in- fossil fuels (coal, oil, gas) into mechanical or electrical energy through the expansion of steam from a high pressure to low pressure in a suitable prime mover (turbine), as shown in Fig. 1. Steam is generated in boilers by burning fuel in furnaces and is conveyed to the prime movers through pipelines. So, steam from a certain section of the turbine extracted for the industrial purposes and the remaining steam is allowed to expand in the turbine).

For the efficient functioning, it is essential that various systems of the plant remain in upstate as far as possible. However, during operation they are liable to fail in a random fashion. The failed elements can however be inducted back into service after repairs/replacements. Sunand et al.[12, 13] states that the rate of failure of the

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