Chapter 8
Modelling Analysis and Simulation for Reliability Prediction for Thermal Power System

Vikram Kumar Kamboj
School of Electronics and Electrical Engineering, Lovely Professional University, India

Kamalpreet Sandhu
School of Design II, Product and Industrial Design, Lovely Professional University, India

Shamik Chatterjee
School of Electronics and Electrical Engineering, Lovely Professional University, India

ABSTRACT

The size of the power system is growing exponentially due to heavy demand of power in all the sectors (e.g., agricultural, industrial, and commercial). Due to this, the chance of failure of individual units leading to practical or complete collapse of power supply is common to be encountered. The reliability of power system is therefore the most important feature to be maintained above some acceptable threshold value. Furthermore, the maintenance of individual units can also be planned and implemented once the level of reliability for given instant of time is known. The proposed research therefore aims at determining the threshold reliability of generation system. The generation system consists of boiler, water, blade angle in turbine, shaft coupling, excitation system, generator winding, circuit breaker, and relay. This chapter presents the mathematical model of reliability of individual components and equivalent reliability of the entire generation system. It suggests the approach to determine the critical reliability of both individual and equivalent reliability of the generation system.

DOI: 10.4018/978-1-7998-1464-1.ch008
INTRODUCTION

The size of the power system is growing exponentially due to heavy demand of power in all the sectors viz. agricultural, industrial, residential and commercial ones. As such the chance of failure of individual units leading to practical or complete collapse of power supply is common to be encountered. Also a most successful power system is one which works with minimum interruptions. The reliability of power system is therefore most important feature to be maintained above some acceptable threshold value. Further the maintenance of individual units can also be planned and implemented once the level of reliability for given instant of time is known. The research proposal therefore aims at determining the threshold reliability of generation system. The generation system consists of boiler, water, blade angle in turbine, shaft coupling, excitation system, generator winding, circuit breaker and relay. It is therefore the reliability of generation system shall be effected even when any one of the component’s reliability is at stake. The Generation System is basically the heart of any power system. The collapse of generation system leads to the biggest collapse, the recovery of which is not only time consuming but tougher than any other system such as Transmission system and Distribution system. The failure of Generation System leads to prolonged interruption period besides being uneconomical. Thus the reliable operation of Generation System needs a thorough care and periodic servicing of its constituent parts such as boiler, turbine, generator and circuit breaker. Our industries, agriculture and software companies require consistent and uninterrupted power supply for toing the needs of continuous customer demand. It therefore drew the attention of researcher to determine the condition when reliability of generation system would be at stake. Further due to complexity of generation system, the determination of its reliability is filled with risk of skipping of some important factors which are responsible for loss of reliability. Thus, it needed a trusted and proof model to deal with the reliability of Generation System. Moved by these innovative ideas the research for assessing the reliability of Generation System has been undertaken. The reliability is based on the incremental reliability of its parts, which includes boiler, turbine, generator and circuit breaker. The chapter therefore presents a mathematical model for determining the reliability of generation system expressed as equivalent reliability by taking each of its component all together. In order to validate the result a model of ANN has been developed to obtain the reliability of Generation System. It could be found that the results obtained by two methods agree with each other. It is therefore possible to estimate the threshold value $R_{th}$ of equivalent reliability upto which the Generation System can be taken to be reliable. It however loses reliability beyond threshold value of equivalent reliability.

Problem Formulation

It is aimed to assess the reliability of consider a Generation System consisting of:

1. Mechanical Unit which again consists of boiler and turbine.
2. Electrical Unit which again consists of Generator and Circuit Beaker as shown in Figure1.
3. Obtain Mathematical model of equivalent reliability, Req of Mechanical and Electrical Units.
4. Obtain validation of reliability assessment made by mathematical model by way of ANN model.