

**UNIVERSITI TEKNOLOGI MARA**

**RISK-BASED UNCERTAINTY OF POWER  
SYSTEM USING BOOTSTRAP TECHNIQUE**

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Thesis submitted in fulfillment of the requirements  
for the degree of  
**Master of Science**

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## **Author's Declaration**

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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## **ABSTRACT**

The main role of a modern electric power system is to provide cost-effective electrical energy to its customers with a high degree of reliability. Hence, power system utility must ensure that they could provide adequate and quality energy supply to customers. However, this has been a major challenging issue experienced by most countries as the power system blackout is unexpectedly occurs. There are various approach used to prevent from the occurrence of power system blackout in order to ensure the sustainability and efficiency of energy supply. Generally, power system blackout can be mitigating by having risk assessment analysis. There are various methods used in evaluating the risk of a power system. This research focuses on a method to perform risk assessment of power system that takes into account the system failure indices and uncertainty of unavailable load variations estimated by using the bootstrap technique and fuzzy set technique. The risk of the system is measured by using the expected energy not supplied (EENS) index as well as the probability of load curtailment (PLC). The bootstrap technique is a sampling method which provides simplest way to perform risk assessment of a power system. Furthermore, it also requires very little assumptions to carry-out the risk analysis and it is imperative for a small size of available information. The application of bootstrap technique is important to assess the risk indices at every level of system uncertainty. The IEEE 24-bus Reliability Test System (RTS) and 2737-bus Polish system are used as a case study in the analysis of system risk severity based EENS and PLC. Comparative studies have been made on the risk assessment of the power system determined by using bootstrap technique and fuzzy set which has been developed by other researcher.

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