Ain Shams University
Faculty of Engineering
Electrical Power and Machines Department

Electric Power System Blackout Prevention using Automatic System Separation

A thesis submitted in partial fulfilment of the requirements of the M.Sc. in Electrical Engineering

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STATEMENT

This thesis is submitted to Ain Shams University in partial fulfillment of the requirements of Master of Science degree in Electrical Engineering.

The included work in this thesis has been carried out by the author at the department of electrical power and machines, Ain Shams University. No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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ABSTRACT

This thesis presents a proposed method for Automatic System Separation or Controlled Islanding to overcome the Blackout problem in the power networks.

Chapter 1 includes an introduction to the Blackout problem and its historical events. This chapter also illustrates power system states prior to and after Blackout to trace Blackout stages. Many actions can be done to prevent Blackout occurrence based on the current state of the power network. These actions are classified into three defense lines. One of the third line actions is the Automatic System Separation (AS) or the Controlled Islanding (CI).

Blackout causes, impacts and solutions are also shown through chapter 1.

Chapter 2 includes the case study in this work which is the IEEE 39 bus 10 machine system. This power network which is known New England system has been widely used in the power system studies. A static analysis is done for this system showing the power flow in each line of the network. Moreover, a dynamic analysis is also done at different system contingency conditions. Some of these contingency conditions may lead the system to be unstable while the others do not affect the system stability. Concern is given to the unstable system conditions as it will be used later in this work.

Chapter 3 includes a literature review on the methods of the Automatic System Separation. These methods can be divided into the predetermined methods and the online methods. Some of these methods were applied to the New England system. These methods were tested by being applied to the New England system

with showing the dynamic response of each method after separation. Some of these methods were able to overcome system Blackout. Other methods had deficiencies in treating the Blackout problem.

Chapter 4 illustrates the proposed method of controlled islanding in this work. This method is developed to overcome the deficiencies accompanied with the application of the previous methods. The proposed method is tested on the case study at different system contingency conditions leading the system to be unstable. These conditions are determined through the dynamic analysis implemented in chapter 2. The dynamic response of the system after separation and the final load imbalance are shown at each unstable contingency condition. This method is proven to be effective as demonstrated by the obtained results.

Chapter 5 includes a general conclusion on this work. It also includes the recommended future work for the enhancement and development of the proposed method in this work.

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