LINE SENSITIVITY ANALYSIS WITH RESPECT TO LINE OUTAGE AND LOAD VARIATION

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ABSTRACT

Voltage stability problems have been one of the major concerns by the electric utilities as a result of heavy loading. Many researches have been conducted concerning to the voltage stability condition in a power system. It is done to ensure that the system operates in a safe condition and necessary precautions can be taken against the voltage collapse. Research has shown that, contingency problem resulted by line outage and load increased was identified as one of the contributors to voltage instability in a power system. Hence, voltage stability assessment is important for power system planning and operation to ensure the system can withstand from any contingency that would affect the customer service.

There are many methods to access the voltage stability condition in a power system. One of the assessment methods which are normally used is sensitivity analysis technique. This project presents the development of sensitivity analysis technique to access the voltage stability condition in a power system. It is based on the assessment of sensitivity of the line with respect to the line outage and individual bus load variation. The information from the line sensitivity analysis can be used to assess the voltage stability condition in a power system. As a result, the most sensitive line that would cause voltage instability can be determined. In this research, Normalise Sensitivity Index *(NSI)* was developed and used to check the sensitivity of each line with respect to the line outage and individual bus load variation.

All the analysis was done on the IEEE 30-bus reliability test system and static stability analysis was considered in this research. The result shows that this technique is capable to predict the most sensitive line in the system due to line outage and individual bus load variation.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays, voltage stability has become a major concern by the electric utility in designing, planning and operating of electric power system. With the continuing increase in demand of electric energy for the use of industrial and domestic, power system will continue to grow both in size and complexity and makes it desirable to operate closer to the stability limit. The system is said to be unstable when the voltage magnitude is above 1.05 pu and below 0.95 pu [1]. Thus, the power system is said to have entered a state of voltage instability when a disturbances causes a progressive and uncontrollable decline in voltage.

Most large power system black-out which have occurred world wide over the last twenty years have been caused by the phenomena of voltage instability [2]. Several major network collapse caused by voltage instability problem were reported in Brazil, New Zealand, Canada, Taiwan, Northeast US and Ontario [3]. Therefore voltage stability analysis is performed to provide information on the system stability to maintain steady acceptable voltage under normal operating condition and after disturbance. Thus, it is important to maintain the system in stability condition in order to avoid from major power blackout and hence could cause large monetary loss.

Contingency problem caused by line, generator and transformer outages are identified as the most common contingencies that could violate the voltage stability in the entire system [4]. Research has shown that if one minute is spent to analyse a single line outage, thus for 30 bus system would require more than 42 minutes to simulate all the line outage. One way to improve speed of solution in a contingency analysis is to use an approximate model of the power system.