

# Contingency Analysis in Power System using Load Flow Solution

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## ABSTRACT

In this paper, the objective is to check the real time security. By two kinds of performance indices, i.e., active power index (PI<sub>a</sub>) and reactive power index (PI<sub>v</sub>) the contingency selection is performed. Using Newton Raphson (NR) iterative method the MATLAB programming code is written for obtaining the solution of load flow equation. Using the algorithm of singular transformation method the MATLAB code for Y<sub>bus</sub> is written as the elements of the bus admittance matrix (Y<sub>bus</sub>) used here. At last for contingency ranking the performance indices are calculated. On an IEEE 25 Bus, 35 Line test system, the effectiveness of this method has been tested.

## Keywords

Contingency analysis, performance index, contingency selection, contingency ranking, security analysis.

## 1. INTRODUCTION

For the power system engineers the maintenance of power system security is one of the most challenging task. In the event of contingency this security assessment is highly essential because it gives the knowledge of the system state. To predict the effect of outages like failure of various power system components such as transformer, generator, transmission line etc. this contingency analysis technique is widely used [10]. It also helps to take necessary action for keeping the power system secure and reliable. As a power system contains large number of components it is a tedious task to predict the effect of individual contingency in offline analysis. In practical basis only selected contingencies will lead to severe conditions in power system [2]. Identifying severe contingencies is a process known as contingency selection which can be done by calculating performance indices for each type of contingency. Contingencies such as single line outages and double line outages are considered in this paper.

## 2. CONTINGENCY ANALYSIS AND THEIR COMPONENTS

By avoiding system troubles before their occurrence is contingency analysis. This happens by studying the outage events and alerting the operators to any potential over loads or serious voltage violations [3]. Mainly four major components of contingency analysis are there that described as follows.

### 2.1 Contingency Definition

The main security function contingency analysis is the study of power system by which change in power flow in lines and bus voltage on the system due to any unscheduled outage of a line component or generator or any disturbances such as change in load demand is assessed.

### 2.2 Contingency Ranking

In descending order contingency ranking is obtained according to the value of a scalar index which is normally called as severity index or performance index (PI). The PI is a measurement of system-wide effect of a contingency event in the system [4]. It is calculated for individual contingency in off line mode using the conventional load flow algorithm. Based on the obtained values contingencies are ranked in such a manner where highest value of PI is ranked first. Basically there are two types of performance indices that are of great use, i.e., active power index (PI<sub>a</sub>) and reactive power index (PI<sub>v</sub>). PI<sub>a</sub> reflects violation of line active power flow and can be calculated using the mathematical expression

$$PI_a = \sum_{i=1}^L \left( \frac{P_i}{P_{max}} \right)^2 \quad (1)$$

Where, L = Total number of transmission lines that present in the system

P<sub>i</sub> = Active power flow in line i

P<sub>max</sub> = Maximum active power flow in line i

$$= \frac{1V_i 2V_p 1 - R 1V_p 1}{1Z 1 - 1Z P}$$

Z = Impedance of the line connecting buses i and p

R = Resistance of the line connecting buses i and p

PI<sub>v</sub> reflects bus voltage magnitude violation and can be calculated by the mathematical expression

$$PI_v = \sum_{i=1}^{n-m-1} \left( \frac{2(V_i - V_{nom})}{V_{nom} - V_{nom}} \right) \quad (2)$$

Where, n = Total number of buses present in the system

m = Total number of PV buses present in the system

n-m-1 = Total number of load buses present in the system

V<sub>i</sub> = Voltage of bus i after load flow

V<sub>nom</sub> = Nominal voltage at bus-i. Generally assumed as 1 pu.

# Contingency Analysis Using Matlab

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