

Module 3 : Frequency Control in a Power System

Lecture 10 : Introduction

Objectives

In this lecture you will learn the following

- Why is maintenance of frequency important?
- An example of typical load and frequency variation in an Indian grid.

Introduction

Frequency all over a synchronous power grid is the same in steady state. Maintaining a near-constant frequency (one may allow frequency to vary over a very narrow band) is considered an important requirement of power system operation.

Frequency in a power system is intimately related to the electrical speed of synchronous generators. The difference between mechanical and electrical torques govern acceleration of a rotor of a generator. Therefore to maintain a constant speed, mechanical input and electrical output power need to be continually matched. Electrical load can vary randomly, but the total load versus time *roughly follows a trend*. For example, total load in a grid can vary over twenty four hours as shown in the figure on the right.

(click to enlarge)

There is a distinctive peak at about 8 pm. This is the typical variation for a particular season of the year. For other seasons, the load profile is different. Also, power systems are not immune to sudden large load or generation throw-offs due to contingencies.

Frequency variation is dependent on several factors which includes the load characteristics and generator prime mover controls. We shall study these issues in detail in the following lectures.

Why is maintenance of frequency in a power system important?

Frequency needs to be maintained near 50 Hz for the following reasons:

- Steam turbine blades are designed to operate in a narrow band of frequencies. Deviation of frequency beyond this band may cause gradual or immediate turbine damage. Consequently, protective and control equipment take corrective action in case of under/over frequency. A 50 Hz steam turbine may not be able to withstand frequency deviation of +2 Hz to -2.5 Hz for more than an hour in its entire life!

- Loads and other electrical equipment are usually designed to operate at a particular frequency. Off-nominal frequency operation causes electrical loads to deviate from the desired output. The output of power plant auxiliaries like pumps or fans may reduce, causing reduction in power plant output.

At the present time, grid frequency deviation in some Indian grids is generally between 50.5 and 49.0 Hz under normal operating conditions. The figure below shows the typical frequency variation in the Western Grid of India (taken from the Western Regional Load Dispatch Center website - www.wrldc.com).

(click to enlarge)

Recap

In this lecture you have learnt the following

- Why is maintenance of frequency important ?
- Typical load and frequency variation in an Indian grid

Congratulations, you have finished Lecture 10. To view the next lecture select it from the left hand side menu of the page.