

Course 501

Analysis and Mitigation of Power System Oscillations

Introduction

The recent power system blackouts in North America and around the world have illustrated the need for more emphasis on power system security assessment in both the planning and operating environments. Today's power systems are often composed of weak transmission connected to a wide range of interacting equipment, controls, and loads. Such systems are susceptible to a variety of potentially harmful oscillatory dynamics ranging from simple local machine interactions to large-scale inter-area oscillations. If not properly analyzed and dealt with, these oscillations, or "small-signal instabilities", can jeopardize system security and even result in widespread system failures. This two-day course covers the theory behind power system oscillations, practical experiences, methods of analysis, and techniques for preventing potentially dangerous oscillatory situations. The subject will be of interest to those working in system planning or operations who wish to learn about this critical aspect of power system security.

Course Contents

1. Introduction
 - Definition and classification of power system stability
 - Conceptual relationship among power system reliability, security, and stability
 - Challenges to secure operation of power systems in the new industry environment
 - Focus of the course
2. Overview of small signal stability
 - Description of small signal stability problems
 - Objectives of small signal stability analysis
3. Utility experience and practice related to small signal stability
 - Incidents of low frequency oscillations
 - Historical review and current status of PSS and other applications
 - Examples of utility experiences
 - Comments on importance of carrying out small signal stability analysis
4. Model development and verification
 - Performance requirements of key equipment
 - Load models
 - Performance verification by simulations
 - Model validation by field testing
5. Analysis methods
 - Time-domain simulations
 - Modal analysis
 - Measurement based methods
 - Complementary use of different analysis methods

6. Study objectives, approaches, and procedure
 - An synopsis of a typical small signal stability study
 - Local modes of oscillations
 - Inter-area modes of oscillations
 - Control modes
 - Torsional modes
7. Power system stabilizer design and tuning
 - Review of PSS
 - Design and tuning procedure
 - Performance verification
 - Case studies
8. Illustrative examples and case studies