Power System Stability and Stabilizer Tuning

Training Course

Industry Need
Utilities have strong financial incentives to maximize power transfer capability while minimizing new transmission, but operating a system in this manner can lead to stability problems. To accomplish this objective in the most cost effective way, utilities are increasingly turning to supplementary controls to stabilize their systems. In particular, the Power System Stabilizer (PSS) has become a widely-accepted method of improving the small-signal stability of electric power systems. There are many considerations in applying a PSS, and each PSS must be tuned according to the particular conditions of the host system. Therefore, the power systems engineer needs to understand this important topic when faced with such a problem.

Objectives
This course will provide participants with insight into the small-signal stability problem and how it can be mitigated by the PSS application. Methods for stabilizer placement and practical tuning techniques will be discussed for the various PSS types of now available. The course will draw on extensive Siemens PTI experience in analysis of oscillatory stability phenomena and in designing, tuning, and PSS commissioning. Finally, the participants will have an opportunity to tune a PSS using the principles presented in the course and Siemens PTI’s PSS™E program.

Prerequisites
Course participants should be familiar with basic control systems theory, such as LaPlace transforms, block diagrams, frequency response techniques, and Bode diagrams. Some background or exposure to synchronous machine theory is also desirable.

Course Structure
The course duration is three and one-half days, presented in three-hour morning and afternoon sessions. The last day concludes at noon.

Documentation
Each participant will receive a bound set of course notes that complement the lecture. The lectures closely follow the notes to minimize the need for note taking in the class.

Instructors
The course will be taught by Siemens PTI engineers with extensive experience in tuning, testing, and PSS commissioning.

Location
The course is conducted on a regular basis at Siemens PTI offices in Schenectady, NY and at other major cities throughout the United States. It is also available for presentation at a client’s location by special arrangement.

Continuing Education Units
2.1 Continuing Education Units (CEU’s) will be awarded for successful completion of this short course. The CEU is the nationally recognized unit for recording participation in noncredit educational programs. One CEU is equal to ten classroom hours.
Course Outline

Day 1
Linear System Dynamic Analysis Methods
• Review of block diagrams, frequency response and Bode analysis

Power System Stability Fundamentals
• Steady state stability
• Transient stability
• Oscillatory (dynamic) stability

Dynamic Characteristics of Generators and Excitation Systems
• Synchronous machine models
• Excitation system models
• Control system tuning

Day 2
Oscillatory (Dynamic) Stability and Power System Stabilizers
• Small signal stability of a generator/excitation system
• Modal analysis of multi-machine systems
• PSS placement analysis
• Non-linear operation (limits and ceiling effects)

AVR and PSS Tuning, Testing and Commissioning
• Tuning methods
• Time domain
• Frequency response
• On-line tuning

Practical Considerations
• Field test on generator/excitation system
• Model accuracy improvements
• PSS Commissioning tests

Various Types of PSS Application Scenarios
• Hydro plants
• Fast valving
• Fast and slow response excitation systems
• Sustained mechanical oscillations

Day 3
Hands-on Example
Participants, working in teams, will tune a PSS using an example generator/exciter provided by Siemens PTI, a time-domain technique learned earlier in the course, and the PSS™E program. (When the course is conducted at locations other than Siemens PTI offices, the hands-on examples may be modified to suit the available computer facilities).

Day 4 (half day)
Continuation of hands-on exercises, review, and discussion