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Impact of Interactions Among Power System Controls

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Chapter 1 - Introduction

- **This chapter reviews recent and current CIGRE work on power system control design issues. It is emphasized that properly coordinated designs can mitigate possible adverse interactions among controls. In addition, advances in computer technology, goal-based and scientific methods are ensuring that the challenges posed by restructured power systems be properly solved.**

Chapter 2 - Power Systems Control and Associated Interactions

- **This chapter gives an introduction to power systems controls and potential (adverse) interactions that can occur between controllers or between controllers and other power system components. First, a summary of the most common controllers used in power systems is given. Then, the general characteristics and mechanisms of controller interactions are reviewed. Finally, a number of cases exhibiting control interactions identified in power system studies or in actual operation of power systems are presented. These cases include interactions between PSSs, between PSSs and FACTS devices, and between HVDC controls and other power system controls. In Appendix D, the main functions of generator controllers are reviewed in the form of simulation results on a test system.**

Chapter 3 - Current Techniques for Analysis and Design Of Damping Controllers

- **The purpose of this chapter is to review techniques that are currently used for the analysis and design of damping controllers (i.e., stabilizers) to improve the dynamic performance of power systems. The controllers which will be considered are power system stabilizers (PSSs), and stabilizing controllers installed on synchronous condenser and FACTS devices such as Static Var Compensators. A procedure for the design of PSSs in multimachine systems is outlined and is illustrated with a practical application and associated test results. An approach is then described for the design of damping controllers installed on two types of FACTS devices, the aim being to coordinate the control of damping of inter-area modes. In Appendix A, the technical issues and the techniques applied for the tuning of stabilizers on the Brazilian system are reviewed**

Chapter 4 - Coordination of Damping Controllers Based on Optimization Methods and the Genetic Algorithm

- **The emphasis in this chapter is on new or improved techniques for the analysis and design of PSSs and damping controllers on FACTS devices. Three aspects are considered, namely, the analysis of interactions between stabilizers, their relative effectiveness, and their coordination. The automated coordination procedures that are examined are based on linear programming, optimization techniques, and genetic algorithms**

Chapter 5 - Enhancing Voltage Stability Using Coordinated Controls

- **In the case of voltage stability, the type and time-sequence of controls are important features in the design of the controllers and their operation. Several approaches to the coordination of controls are discussed. One approach considers the coordination of tap-changing transformers using fuzzy-logic control, the second describes the coordination of capacitor switching, tap locking and load shedding to enhance voltage stability. A method is also outlined for analyzing interactions, adverse to stability, between HVDC terminal stations that are electrically close**

Chapter 6 - Software Tools for Control Design

- **This chapter describes several existing software packages for analyzing interactions among power system components and for designing coordinated controllers to damp oscillations. The relevant features of the programs are described. These features include computational procedures and graphical displays. The material presented provides an overview of software packages designed for application to power systems. Some of the programs described are user-friendly and incorporate good graphical interface for interactive use. The design of a control system is typically an iterative process that combines experience and field observations with sophisticated analytical methods. The objective of the software tools described in this chapter is to facilitate this process**

Chapter 7 - System Testing and Performance Criteria

- **This chapter covers two topics, namely, Performance Criteria and System Testing, in relation to power system damping controllers. From the contributions, it is noted a predominance of frequency domain criteria in practical tuning of damping controllers. A lack of performance criteria regarding interaction among power damping controllers is detected. Regarding System Testing, the chapter presents field tests on two large power systems for damping assessment of major inter-area modes**

Appendices

- **Appendix A Procedures Utilized for Retuning Stabilizers for the North-South Brazilian Interconnection**
- **Appendix B An Analysis of Modal Interactions in Power System**
- **Appendix C Impact of System Restructuring**
- **Appendix D Example Results on Many Functions of Generator Controls**