Thyristor-Based FACTS Controllers for Electrical Transmission Systems

Thyristor-Based FACTS Controllers for Electrical Transmission Systems

by R. Mohan Mathur and Rajiv K. Varma

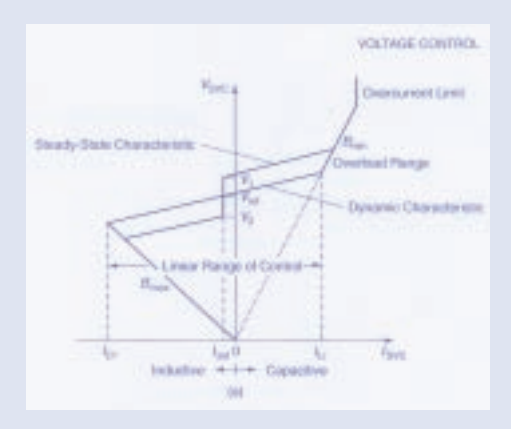
IEEE Press and J.Wiley & Sons,

2002, ISBN 0-471-20643-1, 495 pages

by *Vijay K. Sood,*
Hydro-Quebec, Varennes, QC

Canadian expertise and research in the electrical power industry is well known globally. It is, therefore, fitting that one of the latest books dealing with Flexible AC Transmission System (FACTS) controllers should be authored by researchers with a strong connection to the University of Western Ontario.

The electrical industry is undergoing restructuring to accommodate competing suppliers to reach consumers. Controlling power in a secure efficient manner so that stability and thermal limits are not exceeded requires the assistance of fast, electronic controllers. The book deals at length with the first generation FACTS equipment i.e. the Static Var Compensator (SVC) which has been in service since the 1970s when the acronym FACTS had not even been dreamt of. The other controller that is concentrated on is the thyristor controlled series compensation (TCSC). These two controllers were both based on thyristor technology due to the initial availability of high power and high voltage semi-conductor devices. However, since the thyristor can only be turned on by a gate pulse and not turned off by a control signal, its application had certain control limitations. The second generation switches like the gate-turn off thyristor (GTO) become available in the early 1990s, and led to the new generation of force commutated Static Compensators (STATCOMs) which provided additional levels of control over the earlier equipment. These controllers are dealt with in the latter half of the book.



The book is split into 10 chapters:

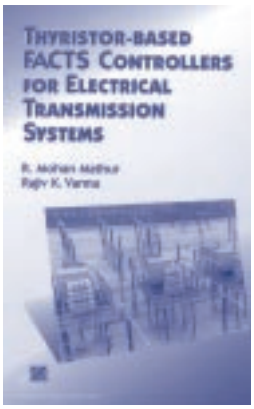
Chapter 1 is an introduction to the subject dealing with the typical control mechanisms employed in power systems, high power semiconductor devices and series/shunt line compensation.

Chapter 2 deals with the fundamental principles of reactive power control and compares the performance of lines with and without shunt-series compensation.

Chapter 3 deals with the principles of conventional reactive power compensators.in a straight forward and effective way.

Chapter 4 deals with SVC components and models. The discussion about measurement systems is useful for students of the subject.

Chapter 5 describes the basic concepts for designing the voltage Controller of a SVC and presents an overview of the topic. Example 5.1 will be interesting for students to gauge the change in the regulator parameters as a function of the short circuit level of the ac system. Sections 5.3.1 and 5.3.2 are practical and describe the critical power system parameters needed to be considered for design of the SVC. Figure 5.15 is very interesting and shows the transient response of the voltage regulator with varying gains. In fact, the figures in all of the book are professionally drawn and presented.



Chapter 6 deals with SVC applications such as stability enhancement, damping of subsynchronous oscillations and improvements in HVDC link performance. A theoretical basis of such applications is presented adequately. However, the lack of discussion of practical examples of such applications is apparent. This may be due to the lack of such data being available from manufacturers and utilities.

One notable exception to the topic is the absence of any reference to the inter-actions between the SVC and HVDC converters at the Chateauguay installation in Quebec. The bibliography at the end of Chapter 6 also did not reflect this. This is perhaps an oversight that the authors might consider for a second edition of the book.

Chapters 7 and 8 focus on the TCSC and forms a core for the book. Chapter 9 deals with coordination aspects of FACTS controllers.

Chapter 10 deals with emerging FACTS controllers and is a brief but adequate overview of such controllers. The subject is so vast that it would not be appropriate for the theme of this book.

I found the Appendix A on the design of an SVC voltage regulator particularly useful. The addition of data for the example is comprehensive and this will form a useful guide to students of the subject.

I read this excellent book with great interest. I found it to both readable and informative. Although the authors did indicate that mathematical material/coverage is not exhaustive, I found it to be adequate for most practising engineer and researcher needs. There are plenty of well drawn diagrams to illustrate the subject matter. The editing has been well done, and is a complement to the proof reader(s) - I did find the odd typographical errors, but nothing too drastic. The book is an excellent compilation in one document of the wealth of material on the topic available from IEEE, CIGRE, and CEA publications.

Following the tradition of the first book on SVCs by T.J.E. Miller in 1982, this book is a much needed update on the technology in a compact edition, and is going to be a valuable addition to the domain of reactive power controllers. It is going to be on the must-read and must-have list of most power utility engineers and academics. It will be a reference book that most technical libraries must obtain.

The CR Editor acknowledges the support of Ms Aida Krneta (email: akrneta@wiley.com), J.Wiley and Sons Publishers for her support of this Book Review.