THE NEW CIGRE TASK FORCE ON COORDINATED VOLTAGE CONTROL IN TRANSMISSION NETWORKS

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ABSTRACT

This short paper describes the preliminary scope and objectives of a new CIGRE task force, under the Advisory Group 02 of the Study Committee 38, on the coordinated voltage control in transmission networks. This report is presented at this panel session to promote a more effective CIGRE-IEEE/PES liaison in this area. CIGRE task forces have a life span of about two and a half years and should produce a Technical Brochure, to be published by CIGRE Central Offices. The panelists of this session, and other CIGRE and IEEE members involved with this subject, are invited to participate in this task force.

1 COORDINATED REGIONAL VOLTAGE CONTROL

There has been increased interest in greater power system automation to relieve operators from repetitive tasks and improve system quality and utilization. Hierarchical voltage control schemes have been utilized in several countries, and the accumulated experience is reported to be highly satisfactory.

The voltage control problem has usually been divided in three hierarchical levels, each one being an order of magnitude slower than the previous. The automatic voltage regulators of the individual generating units, LTC transformers, synchronous condensers and static VAr compensators perform the primary voltage control.

The secondary voltage control provides voltage support to an area of the transmission network in an effective and coordinated manner, chiefly using the reactive power capability of the main generators in that area. This closed-loop scheme may ensure that each generator produces, at any loading condition, the same percentage of reactive power with respect to their MVA ratings. Therefore, all generator units in an area contribute automatically, in a coordinated way within their capability limits, to the area's voltage support under normal operation and during contingencies. This scheme, whose operation time frame is about one minute, regulates the voltage of the area pilot node to a pre-specified value, augmenting voltage stability margins. The secondary voltage control can also act at a substation level, controlling transformer taps, synchronous condensers and static Var compensators, among other equipment.

The tertiary voltage control, which acts every 15 minutes or as events occur, utilizes an optimal power flow program to, among other objectives, minimize MVAr transmission losses and maximize reactive reserves close to load centers, improving voltage stability margins and system security. It is responsible for refreshing the values of the voltage setpoints of the several pilot nodes in the system, updating the MVAr participation of the various generators and controlling capacitor/ reactor banks.

Centralized (coordinated) switching control of capacitor/reactor banks may be very important in some networks, and can be performed at both secondary and tertiary control levels. The coordinated closed-loop control of power plants and substation equipment will keep voltage profile high and flat during heavy load conditions. Other objectives, like reducing the number of shunt capacitor/reactor bank switchings and transformer tap operations along the daily load curve, could also be attempted at the tertiary level.

2 ADVANCED HIGH-SIDE VOLTAGE CONTROL REGULATORS

On the local plant level, there have also been considerable improvements, such as the advanced high-side voltage control regulators, based on modern digital technology, which enhance system operating margins, quality and security. These plant level solutions are gaining widespread utilization, for being effective, relatively low-cost and of simpler implementation.

3 TASK FORCE SCOPE

This Task Force is to produce guidelines for the development and use of coordinated voltage control in

transmission networks. Various activities will be developed, including:

1. Identify the issues related to coordinated voltage control in transmission networks, with emphasis on the experience accumulated in the practical schemes already in operation.
2. Describe the advanced high-side voltage control regulators, the modern solution to local plant control.
3. Assess the benefits of centralized control of capacitor reactor/banks and taps of LTC transformers (at secondary and tertiary control levels).
4. Determine the computer tools required for analysis and design of coordinated voltage control schemes.
5. Describe the existing control system design characteristics.
6. Compare field tests with simulation results.
7. Guidelines for cost-benefit analysis and design of coordinated voltage control schemes.
8. Describe the proposed improvements, their potential advantages and standing problems.

4 DOCUMENT OUTLINE

A CIGRE task force usually starts work with the preparation of a document outline, which gets revised on a regular basis. A first draft for the chapter outline is listed:

1) Introduction
2) Why Use Coordinated Voltage Control? (security, quality and economy aspects)
3) Advanced High-Side Voltage Control Regulators
4) Existing Configurations of Hierarchical Voltage Control
5) Control System Design Characteristics (including communication and state estimation requirements, among other EMS functions)
6) Coordinated Control of Capacitor/Reactor Banks
7) Verified Performance of Existing Systems. Field Results compared with Simulations
8) Tools Required for Analysis and Design
9) Proposed Improvements- Their Practical Advantages and Standing Problems
10) Cost-Benefit Analysis of Different Alternatives
11) Conclusions
12) Appendix: Impact of System Restructuring on Coordinated Voltage Control

5 TASK FORCE MEMBERSHIP, WORK SCHEDULE AND ASSIGNMENTS

The technical report of a CIGRE TF is prepared based on individual contributions, which are compiled into the various chapters. Each chapter has a coordinator or lead editor, who prepares the drafts and sends them to the convenor. The convenor is responsible for editing the entire document drafts and distributing them among the TF members. All correspondence is done electronically.

The meetings of this CIGRE task force will normally be scheduled in conjunction with IEEE PES meetings and CIGRE SC 38 meetings. Their location and time will be published in the IEEE/PES (under the heading of Other Meetings) and CIGRE-Paris conference program booklets. Most meetings are expected to be brief (between 2-3 hours), with the largest portion of work been done independently.

Every national CIGRE committee may appoint one official task force member, but other interested engineers from any country may participate, provide she/he is proficient in the topic of interest. Please contact Nelson Martins (nelson@cepel.br) if you are interested in participating.

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