Scheme of Power System Stability Enhancement using Margin to Apparatus Limitation − Verification of Power System Stability Improvement using Higher Voltage Control on IEEJ WEST 30-machine System Model −

Background

In most cases in Japan, a power transfer limit is not restricted by the heat capacity limits of the transmission line or the transformer. It is mainly limited by the transient stability after some severe disturbances occur in the transmission line. However, the occurrence probability of such severe disturbance is very low. Therefore, it is possible that more economical power system operation can be realized by control utilizing the margin of the apparatus limitations. The scheme which increases maximum power transfer limit of an interconnected transmission line by short-term higher generator terminal voltage control has already been proposed.

Objectives

To verify power system stability enhancement by the proposed scheme with various types of Power System Stabilizer (PSS) in the IEEJ WEST 30-machine System Model;

Principal Results

In this report, the scheme is improved to detect the severe power system fault (3LG-O) using only generator terminal voltage, active and reactive power output. The proposed scheme is applied to 4 or 8 generators in the IEEJ WEST 30-machine System Model, and verified using the CPAT (CRIEPI's Power system Analysis Tools) on condition that one generator has a quick response type AVR with ΔP type PSS (Power System Stabilizer), $\Delta P + \Delta\omega$ type PSS and the Multi-input type PSS. The results show that the power transfer limit of the interconnected transmission line is increased from 5 to 15 %.

It is expected that this scheme can be easily put into practice by changing software of generator excitation system.

Future Developments

The proposed scheme will be verified at CRIEPI's Power System Simulator.

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Reference

(1) Y. Kitauchi, 2004, "Scheme of Power System Stability Enhancement using Margin to Apparatus Limitation (Part II) - Verification of Power System Stability Improvement using Highly Voltage Control on IEEJ WEST 30-machine System Model -", Technical Report R04010 (in Japanese)
(2) Y. Kitauchi, 2004, "Scheme of Power System Stability Enhancement using Margin to Apparatus Limitation - Enhancement of Maximum Power Transfer Limit using Short-term Highly Voltage Control -", Technical Report T03045 (in Japanese)
(3) Y. Kitauchi, et.al., 1999, "Experimental Verification of Multi-input PSS with Reactive Power Input for Damping Low Frequency Power Swing", IEEE Transactions on Energy Conversion Vol. 14, No. 4, December 1999.

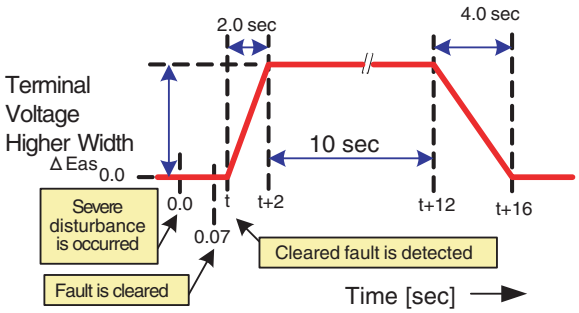


Fig.1 Higher Voltage Control Signal to Add Generator Excitation System

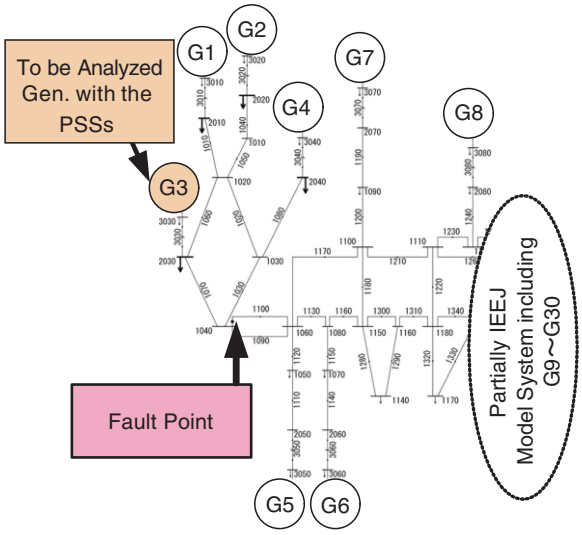


Fig.3 IEEJ WEST 30-machine System Model

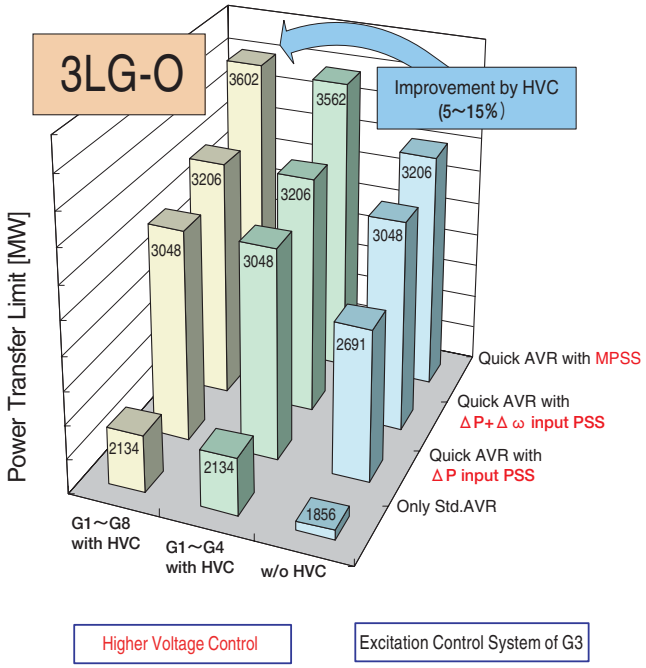
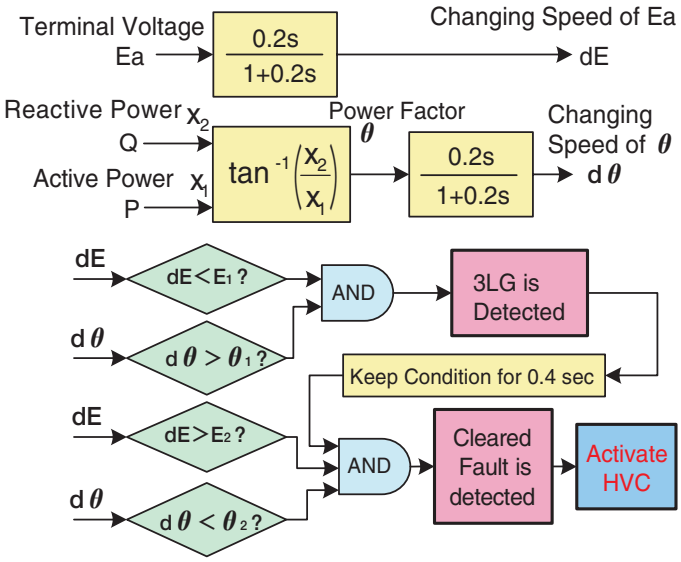
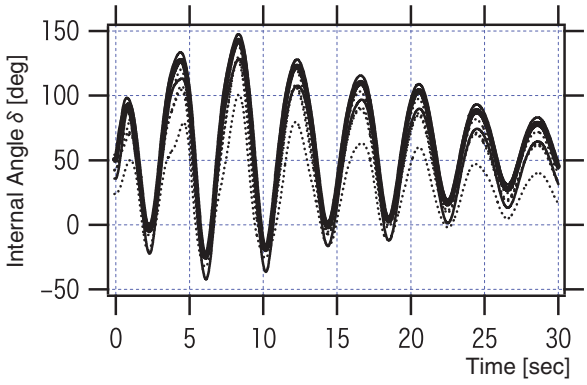


Fig.5 Power Transfer Limit (3LG-O)

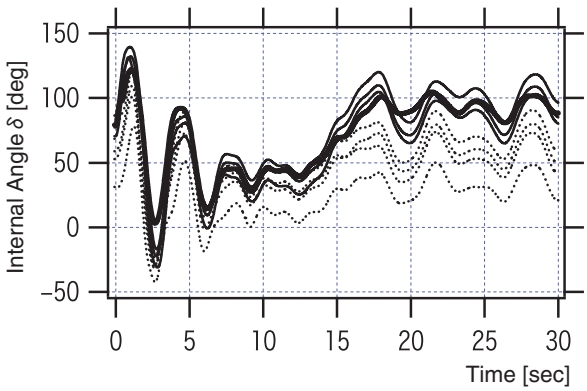


E1=-0.1 pu, E2=-0.05 pu, θ1=10deg, θ2=5deg

Fig.2 Activating Condition of Higher Voltage Control



(a) All Gen. with Std. AVR w/o HVC
Power Transfer Limit 1856MW



(b) G3 with Quick AVR+MPSS with HVC
Power Transfer Limit 3602MW

Fig.4 Simulation Results