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Effects of installed system dumping resistors on stability of open cycle disk type MHD generator connected to power transmission line

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Abstract

This study is performed as part of the wide research on large scale coal fired MHD generation systems. Faults in the power transmission line give remarkable fluctuations to the MHD generator and to the transmission network. Then, it is required to take countermeasures for stable operation of the generation system. The fluctuations do not converge to a stable state after cutting off the fault line in the transmission line because the commutation failure occurs in the inverter system after the line faults.

The effects of installed system dumping resistors (SDR) on the stability of an open cycle disk type MHD generator connected to power transmission lines are numerically studied. Usually the AC SDR is installed in the AC primary grid of the transmission line for system stability. The SDR is used to absorb the output energy of the synchronous generator and to get stability of the power transmission system when faults occur in the transmission line.

In this paper, we propose to install the SDR in the DC lines between the MHD generator and the primary side of connected line commutated inverters. We show that the SDR is effective for system stability by a time dependent numerical analysis. This study makes it clear that switching on the applied SDR using the thyristor switches in addition to cutting off the faulted transmission lines is effective to remove the fluctuations of the MHD generation system.

Keywords: Disk MHD generator; System dumping resistors; Line commutated inverter; Transmission line; Fault analysis; System stability

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1. Introduction

It has been shown that line faults give remarkable influences to the MHD generator and the transmission network and that the control of the inverter is required for stable operation of the generation system [1]. The fluctuations do not converge to a stable state after cutting off the fault lines. It has been shown that control of the inverter angle in addition to cutting off the faulted lines is effective to remove the fluctuations of the MHD system [2,3].

In this paper, we propose to install system dumping resistors (SDR) circuits in the MHD generation system connected to the line forced inverters and power transmission lines. We show that the SDR circuits are effective for system stability by a time dependent numerical analysis. The SDR circuits are installed in the DC lines between the MHD output terminal and the DC primary side of the inverter.

The model of the power system is made for a large scale disk type MHD generator where the thermal input is 1300 MW and the MHD generator output is 235 MW with two pair loads. The voltage and frequency of the transmission line are 275 kV and 60 Hz, respectively.

2. Analyzed system

Fig. 1 depicts the schematic diagram of MHD generator and power transmission system. The model of the power system is made for a large scale disk type MHD generator.

The power network system consists of two SDR circuits, two line commutated inverters, insulating transformers for the inverters, capacitive compensator, the 5th, 7th, 11th, 13th and high pass filters and the double circuit transmission lines. The SDR circuits and inverters are connected to the upstream and downstream output terminals of the generator channel. The infinite bus is assumed in the secondary end of the transmission lines. The voltage and frequency of the transmission line are 275 kV and 60 Hz, respectively.

The disk MHD generator shown in Fig. 2 is a subsonic inflow type and has two pairs of power output terminals, because it has been evaluated by a stability analysis that the multi-load type generator has stable performances [4]. The working fluid is coal fired combustion gas, where the

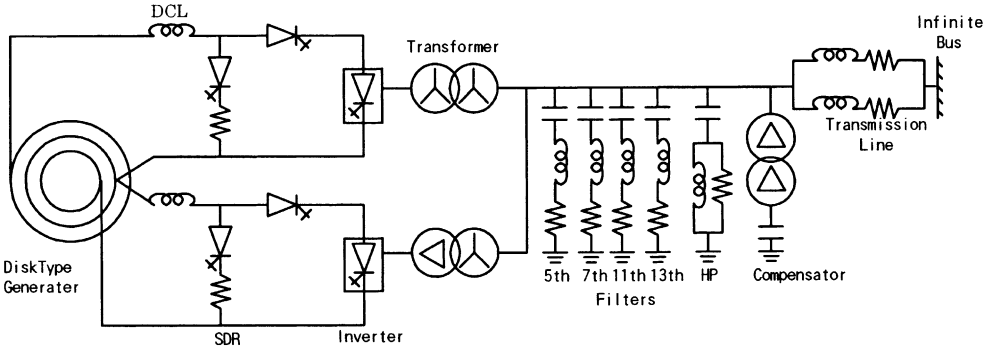

Fig. 1. Schematic diagram of analyzed MHD generator-power transmission system.