§10. Stabilization of 6.6 kV Power Lines for the Experimental Facility in the LHD

Yamada, S., Kitagawa, S.

The LHD experiment will require more than 20 MW heating powers to achieve high temperature plasmas in a high-density regime. The pulsed power for heating experiments by the NBI must be drawn from a 250 MVA motor generator (MG) to keep good condition of electrical line in the site. A modest power of about 8 MW is used to accelerate the MG to operating speed from standby and between pulses. To obtain high efficiency, the Scherbius device is suitable for speed control of the induction motor, as shown in Fig. 1. However, it should be considered that variable harmonic current, which depends on slip value of the induction motor, is induced through the Scherbius circuit. They are estimated to be 1±6ns and 1±12ns. Where, s is a slip value of the induction motor, and n is positive integers. Figure 2 shows the calculated mode numbers of the harmonic currents generated in the Scherbius device as a function of the slip value. The slip value changes from 0.43 to 0.04 as the standby speed of 435 rpm and the rated speed of 662 rpm. In this case, the mode number changes from six to zero.

The impedance analysis of power system in the site predicts that a resonant point appears near the third harmonic frequency of 60 Hz, as shown in Fig. 3 (a). When the variable harmonics from Scherbius device become 180 Hz, they will resonate and be amplified extremely.

To avoid these deterioration, a special harmonic filters of 3 MVar, which does not amplify lower frequency mode less than 190 Hz, were installed in the power line. They have been operated synchronizing with the operation of the motor. In addition, the power supplies for the SC coils, the power supplies for heating devices, the harmonic filters and phase advancers were reconnected to the suitable power feeders with 15 % impedance of the transformers to minimize the harmonic currents in the power line. As a results, a harmful resonant point near the third harmonics could be suppressed, as shown in Fig. 3 (b).

Harmonic current measured in the power supplies of the SC coils has been decreased to less than one fifth. The power factor in the site has been kept in nearly constant value after the reconstruction.

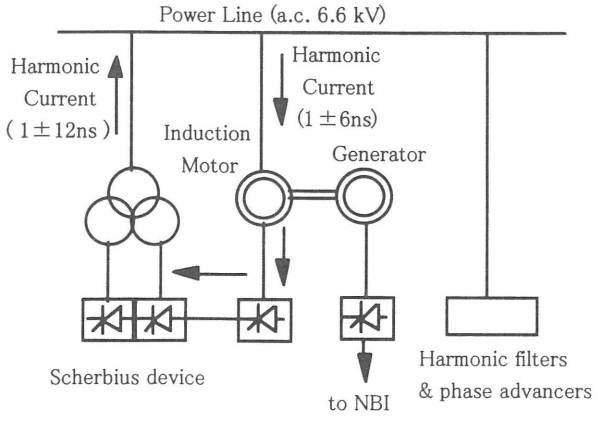

Fig.1 Scheribius device for MG.

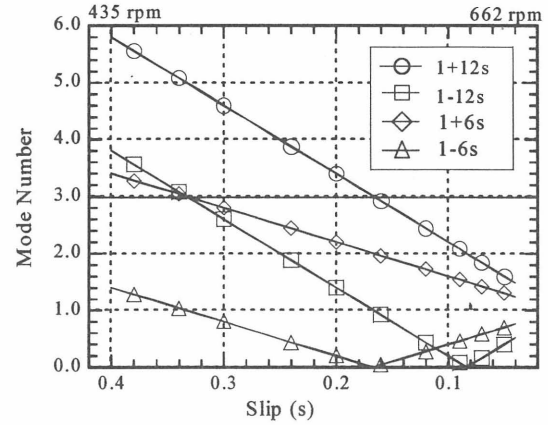

Fig. 2 Calculated mode numbers of the harmonic current in the Scherbius device.

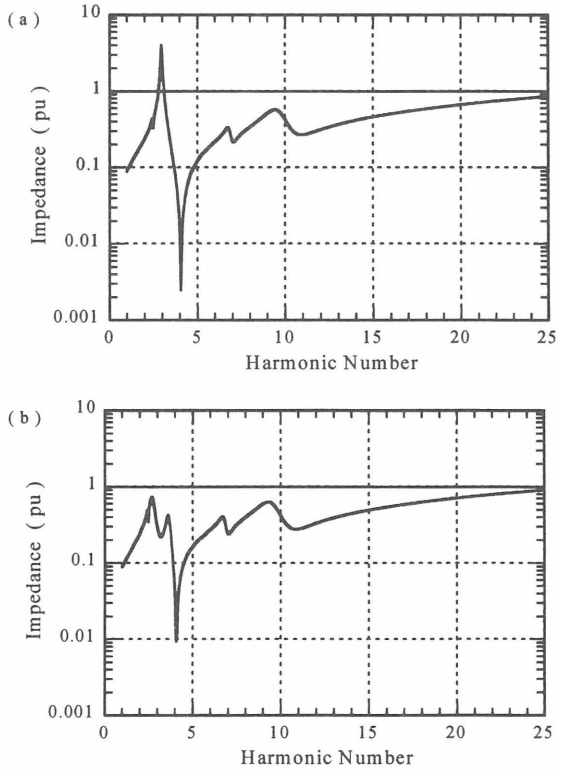

Fig. 3 Results of impedance analyses in the power line (a) before and (b) after modifications.