TRANSPORT PHENOMENA IN MHD GENERATORS

by

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SUMMARY

This thesis presents the investigations of transport phenomena in MHD generators in the presence of inhomogeneities caused by the growth of ionization instability and velocity/temperature boundary layers. Presence of the boundary layers leads to nonuniform heating of electrons across the channel cross-section. The nonuniform heating of electrons affects considerably the growth of ionization instability and the power output. It has been shown that the power output and growth rate of ionization instability both are reduced on account of the boundary layers. Ratio of the power (in the presence of ionization instability) to the power (without ionization instability) is found to increase with the increasing boundary layer thickness. Further, the nonuniform heating of electrons coupled with the temperature boundary layer creates large electron temperature gradients inside the plasma. Consequently, the diffusion of charge carriers across the channel cross-section becomes significant and the electron density is found to deviate from the electron density predicted by the condition of local equilibrium. It is concluded that the overall electron density gets enhanced if recombination and diffusion times are of the same order. The overall conclusion of the present thesis is

that the deterioration in the generator performance on account of boundary layers may not be as serious as believed and careful investigations, which include other boundary effects such as electrical sheath, finite segmentation, leakage currents, end effects, are needed to predict accurately the effect of boundary layers on generator performance.

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