NSE Fusion Oral Exam Mandatory Question. Feb 2017

This question asks you to explore the proposed design of a B=10T tokamak that will produce net energy from D-T fusion reactions. The tokamak has R = 3m, a = 1m and the designers have assumed a large aspect ratio, circular cross section plasma.

a) The designers claim they will operate with central plasma density of $1x10^{21}$ m^{-3} and plasma current of 10MA. Explain from fundamental principles why they can or cannot run with these plasma parameters. Be as quantitative as possible.

b) The designers' plans are vague about how they will drive current in the tokamak plasma. Propose your favorite way to drive the plasma current and explain the fundamental mechanisms of interest in as much detail as possible.

c) Eventually, all the heat from the plasma must be safely exhausted from the tokamak. Propose modifications to the design, if needed, to accomplish this power handling, and justify your proposed changes as quantitatively as possible.