Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Current Drive is Tough - Time to Revisit Pulsed Tokamak Reactors JEFFREY FREIDBERG, DANIEL SEGAL, Massachusetts Institute of Technology PSFC, ANTOINE CERFON, NYU-Courant Institute — The work presented here re-examines the long held consensus in the US fusion community that a tokamak reactor must operate as a steady state, rather than pulsed device. There are two basic reasons motivating this re-examination. First, current drive has proven to be more difficult to achieve than originally believed. Second, the recent development of REBCO high field (23 T) superconductors offers the possibility of substantially reducing the size and cost of pulsed reactors. Our analysis presents a side-by-side design comparison of steady state vs. pulsed tokamak reactors, both subject to standard tokamak physics and engineering constraints. A summary of our main conclusions are as follows. (a) Pulsed reactors are competitive with steady state reactors. (b) Our analysis is focused on a 250 MWe reactor rather than the usual larger 1000 MWe reactors. Lower power reactors are desirable from an industrial competitiveness point of view. (c) 250 MWe steady state and pulsed reactors both require an enhanced value of H above the empirical value H=1, in order to achieve power balance. (d) High field (23 T) is a potential game changer for steady state reactors, improving performance on virtually all fronts. (e) High field helps pulsed reactors, but not as much as steady state reactors. In fact there is an optimum value of the maximum toroidal magnetic field on the coil (about 16 T) that is below the maximum value achievable technologically.

Jeffrey Freidberg
Massachusetts Institute of Technology PSFC

Date submitted: 09 Nov 2020 Electronic form version 1.4