FY16 DOE Research Target (JRT)

Summary: Conduct research to detect and minimize the consequences of disruptions in present and future tokamaks, including ITER. Coordinated research will deploy a disruption prediction/warning algorithm on existing tokamaks, assess approaches to avoid disruptions, and quantify plasma and radiation asymmetries resulting from disruption mitigation measures, including both pre-existing and resulting MHD activity, as well as the localized nature of the disruption mitigation system. The research will employ new disruption mitigation systems, control algorithms, and hardware to help avoid disruptions, along with measurements to detect disruption precursors and quantify the effects of disruptions.

1st Quarter Milestone: Begin planned experiments and analyze experimental results from at least one facility with the goal of studying massive gas injection mitigation of plasmas with pre-existing magneto-hydrodynamic (MHD) modes and to compare to the results with MHD stable plasmas. Develop a plan for a suitable disruption prediction algorithm to be used to analyze disruption data from at least two machines during the second half of the fiscal year. Identify one or more approaches for active improvement of plasma stability in high performance regimes.

2nd Quarter Milestone: Begin planned experiments and analyze experimental results from at least one machine with the goal of studying the benefits of mitigation on runaway growth and decay. Report initial results from at least one facility on the development of automated disruption characterization and prediction software. Carry out joint or complementary experiments on disruption avoidance by active improvement of plasma stability.

3rd Quarter Milestone: Have initiated planned experiments on at least two facilities with the goal of studying massive gas injection mitigation of plasmas with pre-existing magneto-hydrodynamic modes and quantifying plasma and radiation asymmetries resulting from disruption mitigation measures. Continue with development of disruption characterization and prediction. Continue additional experiments or analysis to assess approaches on disruption avoidance by active improvement of plasma stability.

4th Quarter Milestone: Use the disruption prediction algorithm to characterize the reliability of predicting a few types of common disruptions from at least two devices. Test on at least one facility to detect in real time an impending disruption and take corrective measures to safely terminate the plasma discharge. Report on capability to reduce disruption rate through active improvement of plasma stability. Test newly designed ITER-type massive gas injection valve to study the benefits of private flux region massive gas injection vs. mid-plane injection.

Complete the required experiments and analysis. Prepare a joint report summarizing the contributions toward the understanding of the plasma response to massive gas injection in discharges with pre-existing magnetohydrodynamic modes, runaway electron physics, private flux region injection, the reliability of the disruption prediction algorithm for detecting a few types of common disruptions, and avoidance methods for reducing disruption rate.