Fusion Simulation Project

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The conclusions that evolved from the Fusion Simulation Project (FSP) Workshop held in May 2007 and the current status of plans for the FSP are presented. The ultimate goal of the Fusion Simulation Project (FSP) is to develop the ability to predict reliably the behavior of plasma discharges in toroidal magnetic fusion devices on all relevant time and space scales. The Fusion Simulation Project is driven by scientific questions, programmatic needs and technological opportunities. Five critical scientific issues were identified at the workshop as targets for the project. These critical issues are: 1) Disruption effects, including avoidance and mitigation; 2) Pedestal formation and transient divertor heat loads; 3) Tritium migration and impurity transport; 4) Performance optimization and scenario modeling; and 5) Plasma feedback control. These issues are particularly urgent for the burning plasma physics program and for successful operation of the ITER experiment. There is a consensus that the physics models are sufficiently developed and tested so that serious efforts toward integration can begin, but it is also quite clear that the FSP cannot achieve its goals without continuing advances in the underlying theoretical, experimental and computational physics. The FSP requires well supported theory and experimental fusion programs as well as computer science and applied math programs in order to provide improvements to the physics models, the algorithms and the computer science that are at the foundation of FSP components. Improved diagnostics in experimental program are needed to provide accurate experimental data for validation of FSP simulation results. Verification and validation will be a strong element of the FSP and will require close connections with the theoretical and experimental communities. The integrated modeling capability developed through the FSP will be an embodiment of the theoretical and experimental understanding of confined thermonuclear plasmas. The FSP will be, by a very large margin, the largest computational collaboration ever attempted in the magnetic fusion program. Its unprecedented scope and focus will require strong, mission oriented management.