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THE TITAN REVERSED-FIELD PINCH FUSION REACTOR STUDY

SCOPING PHASE REPORT

ABSTRACT

The TITAN research program is a multi-institutional effort to determine the potential of the Reversed-Field Pinch (RFP) magnetic fusion concept as a compact, high-power-density, and "attractive" fusion energy system from economic (cost of electricity, COE), environmental, and operational viewpoints. In particular, a high neutron wall loading design (18 MW/m²) has been chosen as the reference case in order to quantify the issue of engineering practicality, to determine the physics requirements and plasma operating mode (e.g., steady-state operation, a highly radiative core-plasma), to assess significant benefits of compact systems, and to illuminate the main drawbacks. The program has been divided into two phases, each roughly one year in length: the Scoping Phase and the Design Phase. During the scoping phase, the TITAN design team has defined the parameter space for a high mass power density (MPD) RFP reactor, and explored a variety of approaches to the design of major subsystems. Two major design approaches consistent with high MPD and low COE, the lithium-vanadium blanket design and aqueous loop-in-pool design, have been selected for more detailed engineering evaluation in the design phase. The program has retained a balance in its approach to investigating high MPD systems. On the one hand, parametric investigations of both subsystems and overall system performance are carried out. On the other hand, more detailed analysis and engineering design and integration are performed, appropriate to determining the technical feasibility of the high MPD approach to RFP fusion reactors. This report describes the work of the scoping phase activities of the TITAN program. A synopsis of the principal technical findings and a brief description of the TITAN multiple-design approach is given in the executive summary.