

PREFACE

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This special issue covers the results and findings from the ARIES Compact Stellarator (ARIES-CS) study, which was performed to advance the understanding of attractive compact stellarator power plants and to define key research and development areas. The study consisted of three phases. The first phase was devoted to the initial exploration of physics and engineering options, requirements, and constraints; the second phase was focused on the exploration of the configuration design space and on trade-off studies using the system code to converge on the more attractive sets of parameters for a power plant, leading to an integrated design study as part of the third and final phase of the study.

The study was performed by the ARIES Team, which had previously conducted a number of studies of magnetic confinement concepts to assess their economics, safety, and environmental potential as fusion power plants and to identify physics and technology areas with the highest leverage for fusion research. The Team utilizes detailed and integrated physics and engineering analyses (using the most current models available) to perform optimization and trade-off studies. Previous studies include the ARIES-I through ARIES-IV, the ARIES-RS, the Pulsar and the ARIES-AT tokamaks; the ARIES-ST spherical torus; the TITAN reversed-field pinch; and the SPPS stellarator.

As part of the ARIES-CS study, the Team developed compact stellarator configurations for power plant application with low plasma aspect ratios and of sizes comparable to advanced tokamak designs. The effort included local shield optimization to minimize the coil-to-plasma distance, and development of credible modular coil-support, maintenance, and assembly schemes, which would accommodate the geometric complexity and the coil constraints. The final phase of the study focused on a three-field-period configuration with port-based maintenance, a field-period-based coil structure unit, a dual-coolant Pb-17Li blanket, and a high-performance He-cooled T-tube divertor configuration.

The ARIES program is a national effort led by Prof. Farrokh Najmabadi, of the University of California, San Diego, and includes the participation of scientists from U.S. national laboratories, universities, and industry, as well as strong international collaboration. The papers presented in this special issue benefited from the contributions of all the scientists in the ARIES Team. They are acknowledged in the first paper by Prof. Najmabadi.