PREFACE

COMPUTATIONAL METHODS FOR FUSION PLASMA ENGINEERING

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Articles in this special section were collected from presentations at an invited overview session on Computational Methods for Fusion Plasma Engineering sponsored by the Mathematics and Computation (M&C) Division at the annual summer meeting of the American Nuclear Society (ANS) in Los Angeles, California on June 6-11, 1982. Wayne Weber, program chairman of the M&C Division, proposed the session and carried out early arrangements. I interacted with the speakers and handled the processing of manuscripts. Wayne Houlberg and Edward Morse served as cochairmen of the session, which, due to the number of presentations involved, was divided into two parts held on different days. Key participants were, of course, the authors of the various papers. Their willingness to undertake the time-consuming task of developing overview papers (with emphasis on recent developments) was essential to the success of both the meeting session and this special section of *Nuclear Technology/Fusion* (*NT/F*).

The objective of this endeavor is to familiarize members of the ANS M&C Division and the readership of *NT/F* with the emerging field of mathematical modeling and analysis for fusion plasma engineering. Many components of a fusion power plant have features in common with fission plants. The fusion plasma, however, replaces the fission core. Likewise, "fusion plasma engineering" replaces "fission reactor physics" (i.e., the neutronics of the fissionable assembly). Indeed, this analogy can be carried further. During the early development of fission systems, physicists carried out the core neutronics calculations. They called their work "reactor physics." However, as time went on (and the studies became more applied), nuclear engineers gradually took over this effort. Indeed, reactor physics is now almost exclusively taught within nuclear engineering departments in universities in the United States, and a majority of the reactor "physicists" in national and industrial laboratories come from this background. The field is still generally identified as reactor physics, however.

In fusion research, the largest number of professionals are physicists, and a majority of these researchers are involved in "plasma physics." However, as we move toward reactor development, the problems of the plasma core become more applied, the interface between physics and engineering becomes less distinct, and, as happened in (fission) reactor physics, nuclear engineers are becoming involved in increasing numbers. Thus it seems logical to assume that nuclear engineers will gradually assume a major role in this area. (For various reasons, there appears to be a movement to call applied fusion plasma physics "fusion plasma engineering," although, as already noted, the equivalent name-change never occurred in reactor physics.)

The involvement of nuclear engineering in fusion plasma engineering seems natural. Since the nuclear engineer should, by definition, understand the overall nuclear system, academic courses in nuclear engineering departments that stress fusion generally include a healthy dose of plasma physics. Students who find they enjoy this aspect of the system will naturally try to specialize in plasma engineering. (It might be noted that a criticism of early education in nuclear engineering is that it led to "excessive" specialization in reactor physics with the result that research and development on other aspects of fission systems were slighted. Hopefully, this pitfall will be avoided in fusion.)

The purpose of this special section, then, is to provide persons in the nuclear engineering community with a "snapshot" view of some topics and approaches to computational studies in this new field of plasma engineering. For some, this may be just of general interest. For persons working on computational methods for fission reactors, this overview may provide an opportunity to propose adaptation of methods already in use in fission studies. Nuclear engineering educators may be interested in studying the coverage of the field so that appropriate curricula can be developed. For students seeking research topics in fusion, these articles may provide new insight into current computation problems and areas where improvements are needed.

At this point, however, a disclaimer is necessary. Plasma engineering is a very broad field. The articles presented here are intended to present some feeling for the "flavor" of the field, but they cannot be expected to be all-inclusive. Indeed, since plasma engineering is a topical area listed for articles in *NT/F* (see the list of topics in Vol. 2, p. 251), interested readers should scan past issues for other articles dealing with this topic. In addition, most previous articles in *NT/F* (plus this special section) are concerned with theoretical/computational aspects of the field. The equally important experimental aspects of plasma engineering must be considered.

In closing, on behalf of the members of the ANS M&C Division and the *NT/F* readership, I wish to thank the authors for their contribution to this important special session. I hope they will agree that the effort was well worthwhile.