BOOK REVIEW

Selection of books for review is based on the editor's opinions regarding possible reader interest and on the availability of the book to the editor. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.

STARPOWER: The U.S. and International Quest for Fusion Energy

Authors	Gerald L. Epstein, Dina K. Washburn
Publisher	U.S. Government Printing Office, Washington, D.C. (1987)
Pages	236
Price	$10.00
Reviewer	Stephen O. Dean

The congressionally chartered Office of Technology Assessment (OTA) has issued this report (OTA-E-338) of its 18-month study of fusion. It is an impressive, in-depth, well-written treatment containing many useful figures and tables.

In its findings, the OTA analysis states

> Experiments now built or proposed should, over the next few years, resolve most of the major remaining scientific uncertainties regarding the fusion process. If those experiments do not uncover major surprises, it is likely—although by no means certain—that the engineering work necessary to build an electricity-producing fusion reactor can be completed successfully.

The study also finds that

> International collaboration cannot substitute for a strong domestic research program. If the domestic program is sacrificed to support international projects, the rationale for collaboration will be lost and the ability to conduct it successfully will be compromised.

The authors, Gerald L. Epstein and Dina K. Washburn, are to be congratulated for preparing a very readable and comprehensive report of a very complex subject. The report, intended primarily for members of congress and congressional staff, should serve its purpose well; but, in addition, it should provide a valuable resource for news media, members of the public, and the scientific community as well.

The study investigates fusion from many different points of view. Separate chapters are devoted to fusion viewed as a science and technology program (Chap. 4), an energy program (Chap. 5), a research program (Chap. 6), and an international program (Chap. 7). There is a chapter on the history of fusion (Chap. 3) and a final chapter on future paths for the magnetic fusion program (Chap. 8). There is an excellent 23-page executive summary (Chap. 1) and a brief introduction and overview (Chap. 2). There are four excellent appendixes, which treat nonelectric applications, other approaches to fusion, data for figures, and a glossary.

A weakness of the study is its relegation of inertial confinement fusion to a brief discussion in the second Appendix. Inertial confinement fusion is a major U.S. fusion effort and deserves more serious consideration than this report suggests. This slight is presumably due to the U.S. Department of Energy and congressional split personality that budgets for and manages inertial fusion as a weapons program rather than as a civilian program.

Press reports on the study have emphasized, out-of-context, the report's finding that "Even under the most favorable circumstances it does not appear likely that fusion will be able to satisfy a significant fraction of the Nation's electricity demand before the middle of the 21st century." The report as a whole portrays a successful research program meeting its objectives within the constraints imposed by budget stringencies.

The report finds that

> With appropriate design, fusion reactors could be environmentally superior to other nuclear and fossil energy production technologies. Unlike fossil fuel combustion, fusion reactors do not produce carbon dioxide gas, whose accumulation in the atmosphere could affect world climate. Unlike nuclear fission—the process utilized in existing nuclear power plants—fusion reactors should not produce high-level long lived radioactive wastes

and that

> If fusion technology is developed successfully, it should be possible to design fusion reactors with a higher degree of safety assurance than fission reactors. It may be possible to design fusion reactors that are incapable of causing any immediate off-site fatalities in the event of malfunction, natural disaster, or operator error.

A remarkable feature of the report is the breadth of topics that are explained. These include fusion physics; descriptions with diagrams of all the confinement concepts; discussions of all the major technologies; university, laboratory, and industry roles; international agreements; and budgetary trends. In its technical descriptions, the report does draw heavily from a recently completed U.S. national planning study led by Argonne National Laboratory (ANL-FPP-87-1).

A strength (or weakness, depending on your point of view) of the report is that it does not take a stand on what *should* be done; rather, it states the facts reasonably objectively and discusses a few options. The report states in its final chapter on future paths that

> Over the next several decades, the fusion research program can evolve along any of four largely distinct paths:
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> 1. With substantial funding increases, the U.S. fusion program can complete its currently mapped-out research plan independently. This plan is intended to permit decisions concerning fusion's commercialization to be made early in the next century. This approach is called the "Independent" path.
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> 2. At only moderate increases in U.S. funding levels, the same results might be attainable—although possibly somewhat delayed—if the United States can work with some or all of the world's other major fusion programs (Western Europe, Japan, and the Soviet Union) at an unprecedented level of collaboration. This path is termed "Collaborative."
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> 3. In the absence of major collaboration, a flat or declining funding profile would force significant changes to be made in the program's overall goals, including a recognition that fusion's commercialization would be delayed from current projections. This path is called "Limited," indicating that progress in some critical areas would be impossible without additional resources.
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> 4. Shutting down the fusion program would foreclose the possibility of developing fusion as an energy supply option unless and until research were resumed. On this "Mothballed" path, progress towards fusion in the United States would halt. Work would probably continue abroad, although possibly at a reduced pace; resumption of research in the United States would be possible but difficult.
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> Current Department of Energy long-range plans for the fusion program are aimed at the "Collaborative" path. If recent funding declines continue, however, or if the United States does not successfully arrange its participation in major collaborative activities, the U.S. fusion program will evolve along the "limited" path.

I would urge all members of the fusion community and all those interested in fusion to read this report. It provides a good description of the context within which fusion is carried out as a federally funded program.

Stephen O. Dean, president of Fusion Power Associates, has been an active fusion researcher and manager for 25 years. As president of Fusion Power Associates, which he cofounded in 1979, he actively explains and promotes fusion to a broad audience that includes congressional staff and science reporters. He sponsors symposia that bring together senior managers and researchers in both magnetic and inertial confinement fusion. As director of the Magnetic Confinement Systems Division at the U.S. Atomic Energy Commission/Energy Research and Development Administration/U.S. Department of Energy in the 1970s, he directed the growth of the major programs in tokamaks and magnetic mirrors at U.S. laboratories. In the late 1960s and early 1970s, he initiated and conducted experimental research in laser fusion at the Naval Research Laboratory.