IEEE★USA

POSITION STATEMENT

Fusion Energy

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Achievement of controlled fusion will offer a sustainable, carbon-free, proliferation-free, and environmentally attractive source of energy for the future. Fuel material is widely available and control of the process is inherently safe. The goal of fusion is to provide humanity with an inexhaustible supply of energy and a stable global environment. Fusion is inherently compatible with other carbon-free energy sources, such as solar and wind, and can provide a reliable, dispatchable power source. IEEE-USA supports continued U.S. fusion energy research to capture these benefits and commercialize the technology.

IEEE-USA Recommends:

- **Expansion of the U.S. government-funded fusion science program:** Research should include a fusion technology-focused program with an energy mission. This will be a critical step towards practical fusion energy and reinvigorate the domestic fusion program.
- **Supporting public-private partnerships to accelerate the development of fusion energy:** Some of the strongest private fusion companies are in the U.S. and they can potentially provide access to unique facilities, including a burning plasma in the mid-2020's, on a faster time scale than more conservative government-funded programs.
- **Support of ITER as a full partner via U. S. Department of Energy (DOE) during the construction phase:** Support should include both funding and commitment of U.S. expertise and support for use of ITER as a scientific instrument during the operations phase, in order to take advantage of the significant international investments in this important facility.
- **Maintenance of a vigorous and stable domestic program, including magnetic and inertial fusion:** This includes consideration of new research facilities, to address physics and technology topics beyond the scope of ITER and private companies. A strong domestic program is critical to attract a new generation of talented scientists and engineers to enter the US fusion workforce. Such a program, coordinated by DOE, should involve national laboratories, universities, and, where appropriate, industrial partners.

Background

Considering the timescale for commercialization, the concurrent evolution of enabling technologies, and the sweeping changes in the worldwide energy picture that will take place in the 21st century, the economic competitiveness of fusion is likely to improve. Recent advances in superconductor technology by a combined academic and private team of MIT and Commonwealth Fusion Systems (CFS) serve as an example of improved economics enabled by a technology innovation coupled to decades of fusion science research.

There has been significant progress in fusion in recent years, including: the aforementioned magnet technology, nearly $4B invested in private fusion companies, the first laboratory burning plasma at the NIF, and the steady progress of construction at ITER. Recent reports by both a panel of experts at the National Academies [National Academies of Sciences, Engineering, and Medicine. 2021. Bringing Fusion to the U.S. Grid. Washington, DC: The National Academies Press. [https://doi.org/10.17226/25991.] as well as a fusion community consensus report [A Community Plan for Fusion Energy and Discovery Plasma Sciences: Report of the 2019–2020 American Physical Society Division of Plasma Physics Community Planning Process, retrieved from [https://sites.google.com/pppl.gov/dpp-cpp] indicate that the fusion field is now ready to transition from a science-focused program to one that also supports fusion technology development, with a goal of an economic fusion pilot plant.

Using the currently projected reactions, fuel supplies are expected to be nearly limitless and will not be geographically limited. Byproducts from operations are not expected to pose problems and may actually have positive value. Waste disposal issues may accrue to plant structural items, but probably no moreso than for fission reactors.

A balanced combination of domestic and international fusion research, including working with private fusion companies, is the most effective means to advance the fusion program and promote U.S. interests. While it is important for the U.S. to continue to participate in ITER, an ongoing international collaboration with the goal of demonstrating the scientific and technological feasibility of fusion energy; a committed and robust domestic research program is also essential to ensure that the U.S. is prepared to compete as a major supplier of fusion power reactors as the technology matures into a commercial energy source. This approach ensures that the U.S. is positioned to play a significant role, while reaping significant benefits from the wide-ranging technological advancements and overall benefits of fusion development and scientific cooperation on a global scale. This is consistent with a recent recommendation from the National Academies of Science [NAS, op.cit.]

Domestic: A vigorous U.S. domestic program is essential to capture and leverage the benefits of prior investments through strong, continuing involvement in fusion physics and expansion into fusion technology. Strong support of existing and new DOE experimental facilities in the U.S., as well as private sector fusion energy ventures, will ensure continuity and inflow of the requisite scientific and engineering workforce. Opportunities exist for the U.S. to take on leadership roles in key developmental areas, as well as alternative and/or enabling concepts that may optimize the fusion energy system. New domestic facilities should be considered in order to make technical progress in these areas and facilitate U.S. leadership.

A vibrant and vigorous domestic fusion industry will require a stable, long-term commitment of qualified personnel, facilities, and funding to develop the technology. Thus, it is critical that government funding supporting R&D workforce development at universities and national laboratories is stable, if not growing to meet increasing demands. Large projects such as fusion energy development and demonstration need new kinds of funding mechanisms and more long-range thinking. Successful programs in other areas, such as the NASA Commercial Orbital Transport Services, should be used as examples for fusion energy.

International: The ITER project (www.iter.org), initiated in 1988 is an international effort with the mission to demonstrate the scientific and technological feasibility of fusion energy. Involving seven members comprised of 35 nations, the project is the culmination of worldwide efforts to demonstrate the large-scale production of fusion power in the late 2030's. While there are private domestic plans for a burning plasma in the mid-2020's by CFS, ITER will still explore new frontiers of science and technology and demonstrate the ability of a complex international organization to cooperate on a large-scale project at a global level. Adequate funding for U.S. contribution to ITER is requisite to the project's ability to complete construction and begin operations on schedule.

The present fusion knowledge base, which has led the world fusion community to proceed with ITER as well as enable many of the private fusion companies, derives significantly from past decades of fruitful U.S. research and development by a highly productive and innovative U.S. scientific and engineering workforce. Other nations with established and emerging fusion programs, in particular China, U.K., and Korea, are rapidly expanding their own domestic programs and workforce. Now is the time to reinvigorate the U.S. fusion program to ensure leadership as this important technology matures and comes into commercial use.

This statement was developed by the IEEE-USA Energy Policy Committee and represents the considered judgment of a group of U.S. IEEE members with expertise in the subject field. IEEE-USA advances the public good and promotes the careers and public policy interests of the nearly 150,000 engineering, computing and allied professionals who are U.S. members of the IEEE. The positions taken by IEEE-USA do not necessarily reflect the views of IEEE, or its other organizational units.