WHITE PAPER

**Submitted to National Academy of Sciences Panel on Magnetic Fusion Program**

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1. The production of fusion power depends upon the development of an understanding of burning plasma physics and of the development of the supporting reactor-relevant materials and technology.
2. In 1978-88 many hundreds of the world’s experienced fusion physicists and engineers from the USA, USSR, EC and Japan joined together in the IAEA International Tokamak Reactor (INTOR) Workshop to examine: a) if the status of fusion development was such that it was reasonable to undertake the development of a fusion experimental power reactor with a burning plasma to be operational within a few decades; and if so, b) to identify the required additional physics and technology R&D that was necessary over the following decade and c) to define a conceptual design of such a device. The INTOR Workshop a) concluded that it would be feasible to construct and operate a burning plasma device within a few decades based on the tokamak confinement concept and reactor-relevant technology which could be developed within that timeframe, b) identified priorities for physics and technology R&D, and c) defined a conceptual design for such a device.
3. Based upon the results of the INTOR Workshop, Sec. Gorbachev suggested to President Reagan at the 1985 Geneva Summit Conference that the two countries join together to construct and operate such a device. This led to the formation of the ITER project in 1988, originally involving the USA, USSR, EC and Japan, and subsequently involving also S. Korea, China and India. After overcoming numerous political problems causing delays in choosing a site, the imposition of an unconventional financing arrangement and an awkward management structure, the ITER design has evolved to take into account new R&D and the project is now well into construction and moving forward towards initial operation in the coming decade. The ITER design has been extensively reviewed many times by the world’s fusion experts.
4. From the point of view of the development of fusion power, the first priority for the USA fusion program is obviously the successful completion and operation of the ITER device and its full and creative utilization to investigate burning plasma physics in a reactor-relevant environment.
5. Several elements of the US fusion program are making strong and important contributions to supporting ITER operational readiness. The one operating US tokamak experiment, DIII-D, provides valuable experimental input for ITER operation planning, the tokamak-like spherical torus NSTX will also be able to provide relevant experimental information in support of ITER when it becomes operational again, and much of the ITER-relevant expertise in the US fusion community is involved in ITER advisory committees. ITER would definitely suffer from the absence of this USA plasma physics and fusion technology input.
6. There are other elements of the US fusion program, largely based in universities, whose interests are focused more on the basic science aspects of plasma physics or on alternate plasma confinement concepts that might lead to more favorable power reactors than the tokamak concept. I believe that the development of any other confinement concept to the present status of the tokamak would take a redirected program and at least 20 years, and I am not aware of any independent (e.g. ARIES-type) design study that projects that any other confinement concept leads to a better power reactor than the tokamak.
7. While I believe that both alternate confinement and basic plasma physics research are valuable to the long term future of fusion, I also believe that the university fusion research community represents an enormous and under-utilized intellectual resource which could make an essential contribution in the near-term to the success of ITER by anticipating physics and technology issues that may arise with the operation of ITER in new regimes of physics and technology, and developing possible solutions in advance. I suggest that OFES organize such a systematic activity involving the US university fusion community and others.