

A Next-Step Planning and R&D Activity for the FES Program

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With the ITER project now under way, all of the nations engaged in fusion R&D are now seriously considering the programs and the fusion nuclear facilities that will take the next major steps toward harnessing fusion energy. In the U.S., a growing fusion materials science program is envisioned, with a Fusion Nuclear Science Facility (FNSF) as a major next step. The possibility of such a program is exciting, so much so that several U.S. institutions have undertaken studies of possible FNSF missions and designs.

No one knows when the budget expansions needed for such a program might occur, but opportunities can arise unexpectedly. If we hope to capitalize on opportunities to move forward toward fusion energy, we need to be ready with a plan and a convincing case for it. Such a plan needs to have a sound scientific and technical basis, a sound rationale in the international context, and strong support within both the community and DOE. We are far from ready now, and we will not come up with such a plan overnight. We need a sustained national activity, funded by DOE, in order to develop a technical plan and make the case for an FNSF and a program to harness fusion energy. The activity must be put in place now, and must go forward under any of the budget assumptions in DOE's charge to FESAC.

Planning Deliverables

One way to think about what is needed is to consider the first step in the DOE system for managing a large capital project like an FNSF, approval of Mission Need. Surely the case for an FNSF and the accompanying program will be scrutinized at very high levels scientifically and politically, probably including National Academy review. What would the Mission Need case for an FNSF, a multi-\$B facility, consist of? We can reasonably assume that at least the following would be needed:

- Mission description: knowledge to be generated via the proposed program, and how it will advance the science and technology.
- Concept design and rough cost: a convincing existence proof of a facility design that can meet mission requirements.
- Readiness and risk assessment: the physics basis for the proposed magnetic configuration and the technical readiness of the technologies to be used. To the extent that there are gaps in readiness, what is the associated risk? What are the proposed mitigation measures?
- The roadmap to fusion energy and the associated timeline implied by the proposal. If the program is successful, how far will it take us? Would DEMO follow or would there need to be another step?
- International assessment: what is the relationship to ITER and the programs of other countries? How will FNSF best enable a world-leading U.S. program?
- Alternatives assessment: why are the proposed mission and the proposed scientific and technical approaches the best choices among the available options?

The Needed Activity

In order to start building the case and be ready when opportunities arise, a national Next-Step Planning and R&D Activity needs to be put in place now. Needed elements include the following:

