

Comments for the FESAC Panel on MFE Priorities

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*These slides represent my own personal views alone and have not been discussed with or vetted by other UCSD colleagues...

... but they are colored by my work on the FNS Panel & on FESAC International Collaboration & Materials Panels

Externalities & Boundary Conditions

- Current US energy focus is on technologies and approaches that offer nearer term energy prospects
- Fusion has many open issues & does not appear in any serious US energy scenarios
 - Result: impact on high level resource allocation
- US Community has said since Snowmass 2000 that ITER was our highest priority
 - In the face of tight budgets, community support is slipping (see some talks to this FESAC subpanel)
 - **What precisely then does “highest priority” mean, if not that should it become necessary we give up other things first?**
- ITER is a current major DOE/SC focus
- A pullback on community support for US ITER effort will simply exacerbate the credibility issue and lead to further erosion of support for fusion research

**→ OUR FIRST PRIORITY MUST BE TO
WORK TO ENSURE ITER SUCCESS**

We Must Go Beyond ITER*

- Can We Operate Tokamaks on Necessary Timescale ($\sim 10^7$ sec)
 - Achieve required performance (confinement, beta, CD, fueling,)
 - Integrate Steady-state subsystems w/ reactor-relevant walls and tractable divertor solution
 - Avoid/mitigate/safely terminate disruptions
- Can we identify PMI/PFC solutions (**if any**) that work
 - Solid W/He Gas cooling leading candidate but have **ZERO** operational experience
 - Liquid Li Wall: exciting impact on confinement but **ZERO** operational experience; **extraordinarily serious safety concerns**
 - ONE Li fire in a T-filled MFE facility will destroy the perception of fusion as a “safe” nuclear technology (perhaps the primary (only?) advantage that fusion currently has)
 - Actively cooled Li-Li Wall has same damage concerns from REs as does solid wall...
- Can we close the fuel cycle?

* Greenwald Report, ReNeW, Feb'12 FESAC Reports, Interminable Community Studies

Some current key metrics are FAR (>>10x) from what is needed

- **Integration** of FNSF-like Core Plasma w/ Relevant Wall (>500C, actively cooled, 1 year operational lifetime...)
- **PMI:** Discharge duration, fuel throughput, retention management, damage-tolerant materials
- **Fuel cycle & Power Conversion:** T retention, migration & permeation; T breeding & handling technologies; materials & designs for these systems

A FNS *Program* is Needed

- **Build a Science-based Research Program Parallel to ITER that Attacks These Issues**
- Program Objective is Clear:
 - Provide scientific & technological basis for a credible FNSF/ DEMO design
- Program **MUST** have Theory/Modeling, Computation & Experiment Engaged in addressing the critical Grand Challenges via hypothesis-driven approach
- Outcome:
 - Fusion could graduate** from DOE/SC and be recognized, resourced & evaluated as a major energy technology development & demonstration effort
- **phrase borrowed from R. Fonck

This Dual Track (ITER & FNS) Program:

- **Addresses the fundamental issue:** lack of technical credibility for fusion
- **Forms a coherent science-based program:**
 - Address the technical issues including & looking beyond ITER that have been identified in terms of hypothesis-driven research programs (e.g. See FESAC 2/12 Documents for Grand Challenge questions)
 - **THE DEVICE is NOT the program**
 - Program objective: provide the credible scientific basis for considering fusion as a real energy source

We need to be realistic...

- Push hard, but recognize budgets may not increase substantially from current levels
- Recognize that FES is not working in opposition to the community
- Remaining US confinement devices will not be leading facilities in ~5 years (& thus may not make sense to then operate)
- Recognize value of US community is the **EXPERIENCE, KNOWLEDGE & UNDERSTANDING** we have
 - Must continue to nurture via continued science discovery
- Recognize the opportunity for collaboration on new >\$1B confinement facilities overseas
- Supplement Overseas Collaboration w/ upgraded/smaller scaled *non-confinement* US facilities focused on FNS Grand-Challenge Questions

Some hard truths to face

- The time horizon for the remaining large US confinement facilities is probably no more than ~5 years
- We likely will not have resources to pursue ITER and FNS Program AND simultaneously
 - Advocate for new stellerator
 - Push ST & Conventional Tokamak for >5 years
 - Pursue Multiple PMI Technologies
 - Have large on-going HEDLP, Basic Plasma Sciences
 - Potentially incorporate an IFE element into the FES scope
- I think we need to focus on ITER & FNS Program
- **EITHER THIS COMMUNITY ENGAGES WITH FES IN MAKING RATIONAL CHOICES OR BY DEFAULT WE CHOOSE TO HAVE THOSE CHOICES IMPOSED ON US**