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 (~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 faculty 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