Comments to FESAC Open House at Snowmass Fusion Summer Study

Professor James D. Callen
University of Wisconsin

July 16, 2002

FUSION HAS A UNIQUE OPPORTUNITY TO GROW -- BY ADDING AN ENERGY FOCUS, BPX

(mainly from mtg. with Ray Orbach, Director, DoE Office of Science, June 28)

- Administration-Endorsed Statement By DoE Secretary Abraham To G-8 Energy Ministers in Detroit on May 2, 2002:

  "the President is anxious to accelerate fusion power as a realistic source of energy"

  (most aggressive of 4 possible statements was chosen)

- Orbach, "Fusion Is At A Fork In The Road:"

  Continue science focus -- he will support at ~$250M/yr

  Add energy focus -- rejoin ITER negotiations?;
  but he seeks fusion community's best judgement on

  "lowest cost, most efficient path to fusion power"

- Other Developments:

  NRC Panel To Consider BPX Strategy in 2003

  House/Senate energy bill H.R. 4 (in conference) calls for DoE BPX plan 7/04

  A science-focused fusion program must compete for its next large experiment with BES, High Energy, Nuc. Phys. in Office of Sci.

  A Presidential Initiative/Endorsement could take fusion to a new level (Blair-Bush agreement?)

- Orbach: **"Constellations are aligned"**

- **BUT**, ? on OMB & Congress -- we will need united front on viable path!

U.S. FUSION PROGRAM

- Current Policy: Develop Underlying Science & Technology For Fusion
  - -- plasma science, innovation, burning plasma (via int.)

  (OMB, Congress say taxpayers should pay for science and needed technologies for doing it, but not technology development which should be left to the private sector -- and U.S. has lots of energy resources, no perceived crisis)

- Grand Challenges For Fusion Program:

  1) Demonstrate scientific viability ($Q \geq 5$) ⇒ BPX

  2) Develop fusion to highest potential ⇒ lowest cost of electricity
  (new fission reactors: ~$1.5B for 1 GW_e plant, ≤ 4¢/kwh)

- Strategy For Improving Prospects For Fusion Energy:

  Science: increase plasma control and performance through scientific understanding and innovation

  Energy: lower ultimate cost of electricity by developing advanced concepts (AT, liquid Li walls, etc.) and/or innovative confinement concepts (STs, stell, RFPs ...)

A NOTE: Europe and Japan apparently have fewer energy resources, and greater governmental support for technology development -- hence ITER-FEAT has both BPX and technology development missions; and limited focus on science, AT operation

COMMENTS ON THREE POSSIBLE BPXs

Overall: I am for any viable train that leaves the station

- ITER (I worked on/for INTOR '78-82, ITER-CDA '88-91, ITER EDA '90s):

  Lack of site decision in 1998 was tragic

  ITER(1998) → ITER-FEAT right direction, much improved

  Current negotiations are encouraging -- particularly if Europe or Japan (or U.S./Canada) take lead responsibility

  Europe, Japan are also discussing needed "accompanying program"

  ITER has already had significant "opportunity costs"
  - -- U.S. cancelled CIT/BPX in ~1992 to push ITER
  - -- R. Pellat (11/99) "Fusion has lost a decade"

  U.S. should rejoin ITER negotiations -- but pull out if site and construction are not agreed by ? 12/31/03 ? → 5/31/04 ?

- FIRE (I chaired CIT Technical Design Review in 1988?):

  Combined BPX, AT mission is attractive, consanant with U.S. policy

  Would be best U.S. path for a U.S. led BPX with international collaborati
  - -- key U.S. part of international modular strategy, or backup to ITER-FEAT?; would provide site for ICC PE tests or VNS; would make for a logical, viable U.S. fusion program

  U.S. should continue to develop FIRE BPX, AT until ITER decision solidifi

- Ignitor (Member of Pellat/Frendh ITER-FEAT, Ignitor Review Panel, 11/99):

  Possibly quickest route to a BPX if Italy would build it
  - -- and U.S. should seek to collaborate if it is built

U.S. FUSION PROGRAM

- Current Seience-Focused Fusion Program Is Really A $300M/y Program Running On $250M/yr -- Underfunded areas: diagnostics, exp. op. time, theory & comp, plasma support tech. (PFCs..

  (DoE, Congress, Admin, OMB fully support current fusion program at ~$250M/yr)

- Adding Energy Focus Would Require ≥ $50M/yr Increase For Fusion Energy Infrastructure In The Program -- Additions fusion materials, fusion power technologies, IFE (IBX, Z-pinch)

- Possible U.S. Options For Participation In ITER-FEAT:
  (Using ~$10B estimate for U.S. TPC cost structure and including needed R&D for U.S. tasks on an ITER-FEAT)

on which is viable?

50%	$500M/yr -- full partner at Canadian site
30%	$300M/yr -- full partner/influence strategy
15%	$150M/yr -- junior partner/weak influence
5%	$50M/yr -- collaborator/almost no influence

- Possible U.S. Option For **FIRE** BPX, AT:

  ~$150M/yr + $50M/yr. from base tokamak program
  -- build FIRE at a new site that could be used subsequently for MFE ICC PE tests and/or VNS

BUDGET IMPLICATIONS FOR SCIENCE PLUS ENERGY FOCI

- Summary Of Needs Identified On Previous Viewgraph:

Present budget	$250M/yr
Increase in base for viability	$50M/yr
Increase in fusion energy infrastructure	$50M/yr
BPX (ITER, FIRE, or both?)	$150M/yr
	~ $500M/yr

- Possible Budget Evolution To This Level:

FY02	$250M	
FY03	$260M	(increased exp. op. time)
FY04	$350M	(build up base, negotiate)
FY05	$425M	(decide on BPX, fusion path)
FY06	$500M	(begin BPX construction)

- We Should Play The Physical Sciences "Card:"

A revitalized U.S. fusion science and energy program would become a very positive draw for a new generation of fusion scientists, engineers and a positive attraction for the physical science -- if its funding level doubles and it is building a BPX

ADVICE TO FESAC SUBPANEL

1) Reiterate fusion community's "yearn to burn" in a BPX

2) Seize the opportunity -- develop vision for a science and energy focused fusion program that is "lowest cost, most efficient path to fusion power"

3) Highlight "acceleration of fusion power as a realistic source of energy" as an important opportunity to promote physical sciences in U.S.

4) Be realistic about needed funding
-- increase to ~ $500M/yr?, don't undersell!

5) Create momentum for increasing fusion budget
-- to ~ $350M in FY04