U.S. Department of Energy's

Office of Science

Fusion Energy Sciences Program

Fusion Power Associates

Excellent Science Attractive Energy

Office of Fusion Energy Sciences

www.ofes.fusion.doe.gov

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Topics

- Budget
- ITER
- Solicitations
- Reports/Reviews
- Performance Measures

Fusion Energy Sciences Budget Summary

($ in Millions)

	FY 2004 Actual	FY 2005 Cong.	FY 2005 Dec Fin Plan	FY 2005 Jan Fin Plan
Science	142.4	150.8	148.3	155.2
Facility Operations	85.6	85.5	87.5	90.1
Enabling R&D	27.5	27.8	28.3	28.6
OFES Total	*255.5**	*264.1*	*264.1*	*273.9*
DIII-D	54.4	54.0	53.6	55.7
C-Mod	22.3	21.5	21.3	22.0
NSTX	35.6	33.6	33.3	34.5
NCSX	15.9	15.9	15.8	17.5
ITER	3.2	7.0	6.9	4.9

*SBIR/STTR not included

12/10/04

Status of OFES FY 2005 Budget

o Congressional Request	$264.1 M
o Omnibus	$276.1 M
– Increase use of small and large experiments	+4.8 M
– Further work on inertial fusion energy technology	+0.3 M
– Take advantage of opportunities in HEDP	+2.0 M
– Take advantage of opportunities in large-scale computing	+1.5 M
– Provide cost-effective construction of compact stellarators	+2.2 M
– Reduce ITER due to delay in site selection	-2.0 M
– Other (SBIR & Reserves)	+1.0 M
– General reduction and rescission	+2.2 M
o Total Net Fusion	$273.9 M

Allocation of FY 2005 Congressional Add-On

- Increase use of small and large experiments +4.8 M
  - Operate Alcator C-mod and NSTX 17 weeks
  - Continue DIII-D modifications
  - Supplement efforts on several smaller experiments
- Further work on inertial fusion energy technology +0.3 M
  - Focus IFE first wall work on ITER R&D
- Take advantage of opportunities in HEDP +2.0 M
  - Issue RFP for innovative approaches including Fast Ignition
- Take advantage of opportunities in large-scale computing +1.5 M
  - Fund 3rd SciDAC proposal on RF
- Provide cost-effective construction of compact stellarators +2.2 M
  - Provide NCSX contingency and continue QPS R&D
- Reduce ITER due to delay in site selection -2.0 M
  - Fewer project staff, slow procurements
- Other (SBIR + Reserves) +1.0 M
- General reduction/rescission +2.2 M

Site Selection Negotiations Continue

Rokkasho, Japan (northern Japan)

Cadarache, France, EU (southern France)

- **On November 8-9th, 2004, the Fourth Preparatory (Negotiations) Meeting for ITER Decision Making was held at Ray Orbach's level. All six ITER Parties were present.**

Common Message from 4th Preparatory Meeting for ITER Decision Making

(IAEA, November 8-9, 2004)

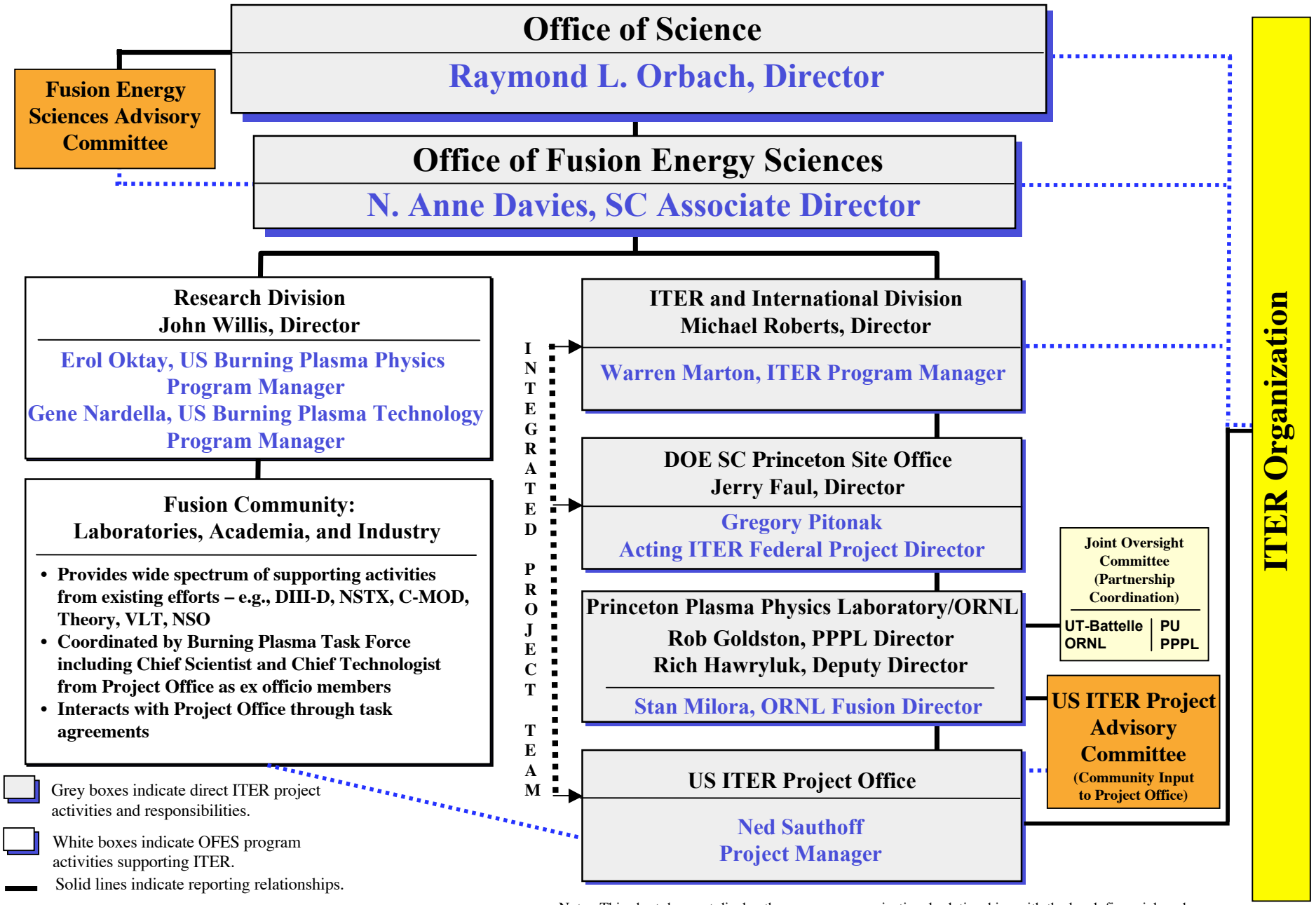
Delegations from China, European Union, Japan, the Republic of Korea, the Russian Federation, and the United States met at the IAEA headquarters in Vienna on 9th November 2004 to advance the ITER negotiations.

The two potential Host Parties, European Union and Japan, presented the results of recent intensive bilateral discussions on the balance of roles and the responsibilities of Host and non-Host in the joint realisation of ITER in the frame of a six-Party international co-operation. These discussions will continue in the near future with the aim of aligning the two Parties' views.

All Parties were greatly encouraged by the positive atmosphere and expressed their optimism that the process was now proceeding effectively towards a fruitful conclusion among the six Parties in the near future.

- **Resolution continues to be largely in the hands of the EU and JA.**

Management Structure for the US ITER Project and Program



Note: This chart does not display the necessary organizational relationships with the legal, financial, and construction management offices within DOE.

Worldwide Tokamak Experiments Validate ITER Performance Projections

- The recent IAEA Fusion Energy Conference highlighted the exciting progress in tokamak research made during the past two years
  - JT-60U, JET, DIII-D, and ASDEX Upgrade all carried out ITER baseline scenario experiments that extrapolate to the $Q \geq 10$ in ITER
  - JT-60U, DIII-D, and JET also demonstrated long-pulse, hybrid scenarios with full non-inductive current drive that extrapolate to high performance in ITER at lower current than the baseline scenario
- An important capability in achieving these results is active control of current and pressure profiles in plasmas, which allows long pulses, limited only by the capability of the heating and power handling systems.
- All oral presentations available at: http://www.cfn.ist.utl.pt/20IAEAConf/presentations_1.htm#Day%201

Planning of a Burning Plasma Program

- The discussions are in progress within the community to define a Burning Plasma Program;
- It involves coordination among a large sector of the OFES programs in experiments, theory and modeling, and technology;
- We are forming a BP Program Team in OFES, and expect that the community will form a Task Force, closely linked to the USIPO, to implement the Program;
- ITPA and ITER Physics Tasks are major elements of a Burning Plasma Program.

International Tokamak Physics Activity (ITPA) and ITER Physics

- 5th ITPA Coordinating Committee meeting held in Shanghai on June 10-11, 2004:
  - Korea joined ITPA.
  - Ron Stambaugh was selected as the new Chair of the committee.
  - Topical Physics Groups are working on the Tokamak Physics Basis update for submission to Nuclear Fusion in December 2004.
- Technical work in ITPA is progressing well:
  - Joint experiments among the world tokamaks, coordinated through ITPA and IEA Agreements, are productive.
  - Next series of Topical Group meetings were held in Lisbon after the IAEA Fusion Energy Conference.
- We need to improve interaction with the International Team on ITER Physics Tasks:
  - ITER relevant experiments and modeling studies should be developed into ITER Physics tasks where specific deliverables have been identified.

Fusion Science Centers

- Competitive peer review in 2004
- 2 centers funded for 5 years, with the possibility of renewal for an additional 5 years
- University of Maryland and UCLA Center will focus on Multiscale Plasma Dynamics using facilities at both of the schools
  - Total funding of $6.4 million over five years
  - Other institutions involved are Princeton University, the Massachusetts Institute of Technology (MIT), and the University of Michigan
  - More information available at: http://cmpd.umd.edu/
- The University of Rochester Center will study Extreme States of Matter and Fast Ignition Physics
  - Total funding of $5.5 million over five years
  - Partners include MIT, General Atomics, University of California at San Diego, Ohio State University, UCLA and the University of Texas at Austin
  - Collaboration with the National Nuclear Security Administration programs at Rochester and Lawrence Livermore National Laboratory
  - For more information see: http://fsc.lle.rochester.edu/

SciDAC Solicitation Summary

- Peer review of new and renewal proposals completed in June 2004
- Two proposals selected for initial funding; third proposal to be funded
- Center for Extended Magnetohydrodynamic Modeling, Stephen Jardin PI
- Center for Gyrokinetic Particle Simulation of Turbulent Transport in Burning Plasmas, W. Lee, PI
- Center for Simulation of Wave-Plasma Interactions, Don Batchelor, PI
- Remaining SciDAC ($1 million) funds set aside to begin work on the SciDAC Fusion Simulation Project (FSP) in collaboration with OASCR, which would provide matching funds

Initiation of Fusion Simulation Project (FSP)

- FESAC identified Comprehensive simulation capability as a critical program element for the future
- FSP – complex project with challenging goals
  - Planning FSP in advance of project initiation is essential
- Planning committee has provided technical assessment of what is needed for integrated simulation

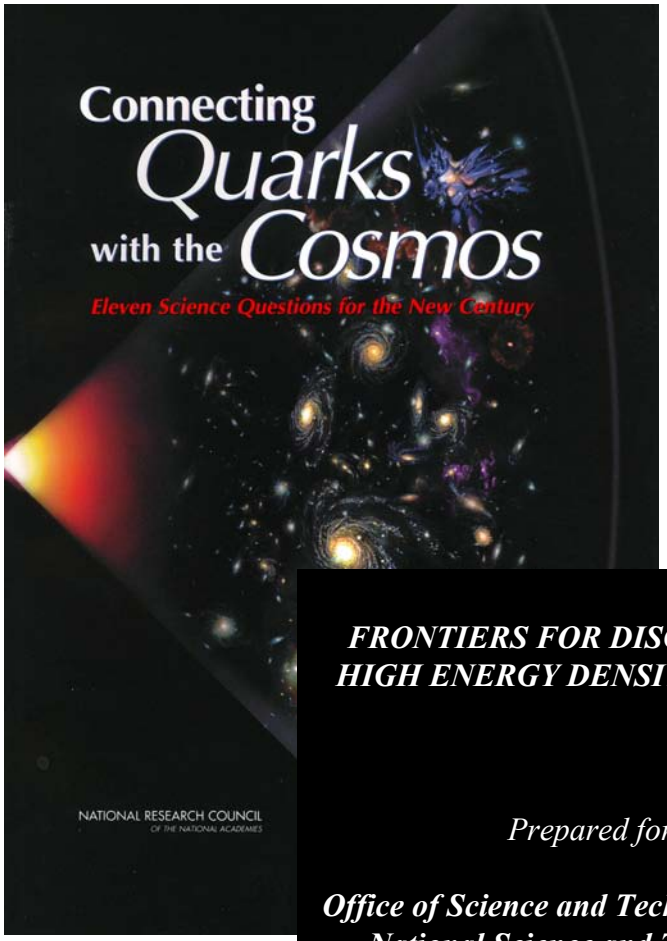
  Doug Post (LANL), Chair; Don Batchelor (ORNL); Randy Bramley (Indiana U.); John Cary (U. Colorado); Ron Cohen (LLNL); Phil Colella (LBNL); and Steve Jardin (PPPL)
  - Many additional 2-D and 3-D physics features
  - New mathematical framework spanning all relevant physics
  - Project-like planning and management
- In FY 05, we will initiate 1-2 multi-institutional FSP pilot projects
  - Fraction of funding at a single institution will be limited

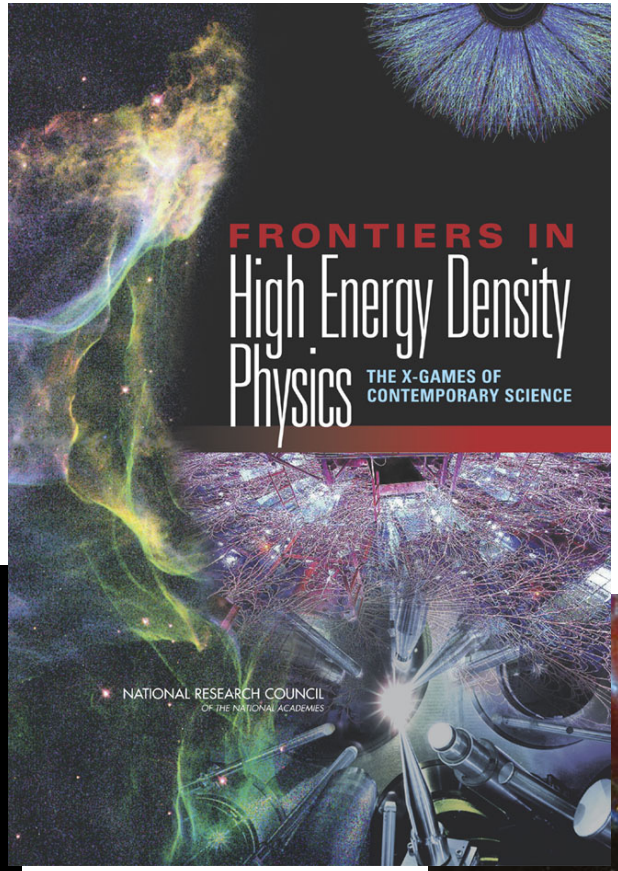
Committee of Visitors

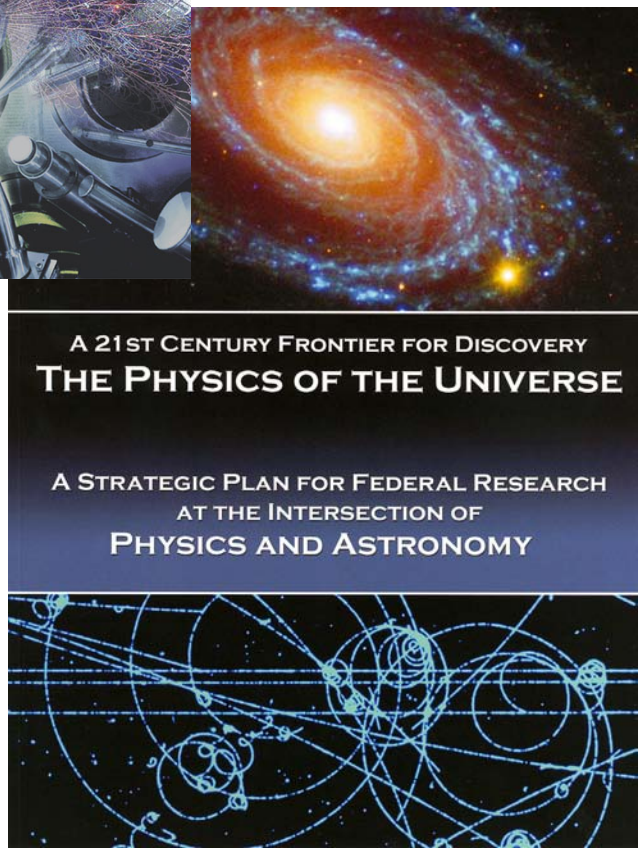
- Modeled on the NSF approach and prototyped by BES for SC
- Using FESAC Panels
- All Program Areas to be reviewed over 3 year period
  - Theory and Computation (FY 2004) completed. Report on the OFES Website
  - Confinement Innovation, Basic Plasmas Science, IFE/HEDP, Junior Faculty (FY 2005)
  - Tokamak Research and Enabling Technologies (FY 2006)

Committee of Visitors (continued)

- Jeff Freidberg, (MIT), will Chair the FY 2005 COV
- Scope of the Panel's work
  - Work with OFES to establish COV procedures and processes
  - Assess efficiency and quality of processes used to
    - Solicit, review, document proposal actions
    - Establish consistency of award decisions with respect to program goals
    - Monitor projects and programs
  - Comment on how awards process has affected
    - Breadth, quality and balance of portfolio
    - National and international standing of program elements
- Schedule
  - OFES site visit at end of January 2005
  - Panel report by mid-March 2005







FRONTIERS FOR DISCOVERY IN HIGH ENERGY DENSITY PHYSICS

Prepared for

Office of Science and Technology Policy
National Science and Technology Council
Interagency Working Group on the Physics of the Universe

Prepared by

National Task Force on High Energy Density Physics

July 20, 2004

Four Major HEDP Research Areas

1. High energy density physics in astrophysical systems;

2. Beam-induced high energy density physics (Relativistic Heavy Ion Collider, heavy ion fusion, high-intensity accelerators, etc.);

3. High energy density physics in Stockpile Stewardship facilities (Omega, Z/ZR, National Ignition Facility, etc); and

4. Ultrafast, Ultraintense Laser Science

International Workshop on Advanced Computational Materials Science: Application to Fusion and Generation IV Fission Reactors

March 31 – April 2, 2004
(organized by ORNL at the request of BES)

- Select international scientific committee convened to determine whether increased effort on modeling and simulation could bridge gap between data needed for design of advanced nuclear technologies and data from existing experiments

- Discussion focused on fusion (where the "gap" is larger)

- Clear consensus that IFMIF-like irradiation facility is needed, but no agreement that IFMIF was the best approach

- Aggressive theory and modeling effort could reduce the time and experimental investment required for materials development

- Complete report available at:
  http://www.csm.ornl.gov/meetings/SCNEworkshop/DC-index.html

FESAC Charge on Prioritized Balancing

- Identify major science and technology issues to be addressed in research campaigns through 2014

- Plan balanced program with ITER as part of an integrated whole

Program Goals and Overarching Themes

- **FESAC Priorities Panel started with a nearly diagonal transformation of the three program goals of the 1996 restructuring…**

– Advance plasma science in pursuit of national science and technology goals.
– Develop fusion science, technology, and plasma confinement innovations as the central theme of the domestic program.
– Pursue fusion energy science and technology as a partner in the international effort.

- **Into three "overarching themes":**

– O1. Understand the dynamics of matter and fields in the high temperature plasma state.
– O2. Create and understand a controlled, self-heated, burning starfire on earth.
– O3. Make fusion power practical.

Charles C. Baker
Panel Chair
FESAC Panel on Priorities

Decadal Study of Plasma Science

- Study will be conducted by National Academy of Sciences, is expected to begin in January 2005, and last 18 months. Dr. Stephen Cowley (UCLA) will be chairman
- Tasks:
  - Assess progress and achievements of plasma science over past decade
  - Identify new opportunities and compelling science questions for plasma science, frame outlook for future, and place field in context of physics as whole
  - Evaluate opportunities and challenges for applications of plasma science to fusion and other fields
  - Offer guidance to government research programs and scientific communities aimed at addressing these challenges and realizing these opportunities
- Follow-up to decadal study of plasma science conducted in 1995

OFES Performance Measures

FESAC has reviewed these Performance Measures and the comments of FESAC members have been included

Long Term Indicators

Predictive Model for Burning Plasmas

Progress in developing a predictive capability for key aspects of burning plasmas using advances in theory and simulation benchmarked against a comprehensive experimental database of stability, transport, wave-particle interaction, and edge effects.

Alternates

Progress in demonstrating enhanced fundamental understanding of magnetic confinement and improving the basis for future burning plasma experiments through research on magnetic confinement configuration optimization.

High Energy Density Physics/IFE

Progress in developing the fundamental understanding and predictability of high energy density plasma physics, including potential energy producing applications.

FY 2005 Annual Program Performance Targets

Answer the key scientific questions and overcome enormous technical challenges to harness the power that fuels a star, realizing by the middle of this century a landmark scientific achievement by bringing "fusion power to the grid."

1. Conduct experiments on the major fusion facilities (DIII-D, Alcator C-Mod, NSTX) leading toward the predictive capability for burning plasma and configuration optimization: In FY 2005 FES will measure plasma behavior in Alcator C-Mod with high-Z antenna guards and input power greater than 3.5 MW.
2. Increase resolution in simulations of plasma phenomena--optimizing confinement and predicting the behavior of burning plasmas require improved simulations of edge and core plasma phenomena, as the characteristics of the edge can strongly affect core confinement: In FY 2005 FES will simulate nonlinear plasma edge phenomena using extended MHD codes with a resolution of 20 toroidal modes.
3. Average achieved operation time of the major national fusion facilities as a percentage of the total planned operation time. FY 2005 - >90%.
4. Cost-weighted mean percent variance from established cost and schedule baselines for major construction, upgrade, or equipment procurement projects. FY 2005 - <10%, <10%