



U.S. Department of Energy's  
Office of Science

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# Fusion Energy Sciences Program

Fusion Energy Sciences Advisory  
Committee Meeting



**Dr. N. Anne Davies**  
Associate Director  
for Fusion Energy Sciences

[www.ofes.fusion.doe.gov](http://www.ofes.fusion.doe.gov)

*July 31, 2003*

# *Topics*

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- o **Budget Update**
- o Office of Science 20-Year Facility Plan
- o ITER Negotiations
- o ITER Organization/US Update
- o National Research Council Reports
- o Performance Measurement
- o New FESAC Charges
- o Committee of Visitors

## ***FY 2004 Fusion Energy Sciences Budget***

(\$ in Millions)

	FY 2002 <u>Actual</u>	FY 2003 <u>Cong.</u>	FY 2003 <u>Aug. Fin Plan</u>	FY 2004 <u>Cong.</u>
Science	134.3	136.2	136.2	138.1
Facility Operations	70.8	78.6	66.0	87.7
Enabling R&D	36.0	36.1	38.5	24.9
SBIR/STTR	<u>0.0</u>	<u>6.4</u>	<u>6.2</u>	<u>6.6</u>
<i>OFES Total</i>	<i>241.1</i>	<i>257.3</i>	<i>246.9</i>	<i>257.3</i>
DIII-D	50.9	55.6	51.5	56.6
C-Mod	17.6	22.3	19.0	22.8
NSTX	28.0 *	33.1	30.0	35.1
NCSX	5.4	11.8	11.7	16.7

\*Operating Only

7/30/03

# *FY 2004 Fusion Energy Sciences Budget*

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House Mark  
(\$ in Millions)

President's Request	257.3
ITER and FIRE	+ 4.0
Fusion Technology	+ 5.2
Advanced Design and Analysis	<u>+ 1.6</u>
<b>House Mark</b>	<b>268.1</b>
High Average Power Laser Research in NNSA	+ 25.0

# ***FY 2004 OFES BUDGET***

## ***House Mark***

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- \$268,110 k (\$10.8 million over the President's Request)
- "The Committee recommendation for fusion energy sciences is \$268,110,000, an increase of \$10,800,000 over the budget request. The Committee is cautiously supportive of the Administration's proposal to re-engage in the International Thermonuclear Experimental Reactor (ITER) project, but is disappointed that the budget request provides \$12,000,000 in funding for the U.S. ITER effort only at the expense of displacing ongoing domestic fusion research. The additional \$10,800,000 includes \$4,000,000 for burning plasma experiments, including support for ITER and for the domestic FIRE project, \$5,200,000 for fusion technology, and \$1,600,000 for advanced design and analysis work. If the Department intends to recommend ITER participation in the fiscal year 2005 budget request, the Committee expects the Department will do so without harm to domestic fusion research or to other programs in the DOE Science budget."

# ***FY 2004 Fusion Energy Sciences Budget***

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Senate Appropriations Committee  
(\$ in Millions)

President's Request	257.3
Senate Appropriations Committee	257.3

“...within available funds, the Department should...redress the imbalance...”

# *FY 2004 OFES Budget*

## *Senate Appropriations Committee*

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\$257, 310 k (same as President's request)

The Committee recommendation for fusion energy sciences is \$257,310,000, an amount that is equal to the budget request.

The fusion energy sciences program supports research emphasizing the underlying basic research in plasma and fusion sciences, with the long-term goal of harnessing fusion a viable energy source.

# *FY 2004 OFES Budget*

## *Senate Appropriations Committee* (continued)

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International Thermonuclear Experimental Reactor.-The Committee recommendation includes the budget request of \$1,990,000 to allow the Department to enter multilateral international negotiations aimed at building the International Thermonuclear Experimental Reactor [ITER], a burning plasma physics experiment many view as an essential next step toward eventually developing fusion as a commercially viable energy source. Reasonably conservative estimates suggest that the United States' participation in ITER will require approximately \$1,500,000,000 over the next 10 years in direct contributions to the construction of ITER and in supporting science. The Department's request of less than \$2,000,000 in direct support of the ITER project for Fiscal Year 2004 certainly leads the Committee to question the Department's commitment to supporting ITER without prejudice or damage to alternative fusion technologies, much less than other Departmental science programs.

~~The Department's proposed fiscal year 2004 budget proposes to cut long-term alternative fusion research such as the exploratory concept area, Inertial Fusion Energy, and chamber technologies. These are the areas, unlike the tokamak or stellarator, which have significant potential for breakthroughs that might make fusion economically feasible and practical, and speed its development compared with the 35-year projections based on ITER-like technology. As such, the Committee recommendation includes \$11,000,000 for such fusion technology under the enabling research and development sub-program. The Department is directed to make a corresponding reduction in the program growth planned for operations/construction and university programs, and redirect it into the technology programs to restore balance. The Committee believes that the initial cost of involvement in ITER should be born by ITER-related concepts like the tokamak and stellarator, not alternative concepts.~~

The Department's proposed fiscal year 2004 budget proposes to cut severely long-term activities in fusion technology and advanced design that will have significant impact on the ultimate attractiveness of fusion power. The Committee recommends that, within available funds, the Department should make adjustments to redress the imbalance resulting from these cuts.



## *FY 2004 OFES Budget Initial Financial Plan*

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- o Will be at \$257, 310 k (lowest of all possible numbers)
- o Conference will not occur before September
- o Principles for Initial Fin Plan Development
  - Minimize personnel disruptions
  - Support ITER Transitional Arrangements, reduce effort on FIRE
  - Rebalance science and technology elements, to some extent
  - Continue NCSX project
  - Solicit proposals for Fusion Science Centers
  - Support National Lab portion of the successful NSF Science Center proposal lead by University of Wisconsin
  - Partially restore cuts to International Collaborations
  - Increase operation of facilities over FY 2003 level

# *Topics*

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- o Office of Science 20-Year Facility Plan
- o ITER Negotiations
- o ITER Organization/US Update
- o National Research Council Reports
- o Performance Measurement
- o New FESAC Charges
- o Committee of Visitors

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## *Status of ITER Negotiations*

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- o Senior Negotiators' meeting: (P series)
  - US delegation led by Raymond Orbach
  - P1 held in June: released Common Message addressing
    - Progress in Cost Sharing, Procurement Allocation, and Key Personnel
  - P2 to be held in early fall
- o Broader Negotiators' meeting: (N Series)
  - N8, last meeting, held in St. Petersburg in February
  - Further meetings in this series are not yet scheduled
- o Working level meetings: (NSSG Series)
  - NSSG has become focus of support for P meetings
  - Now bimonthly eight-day set of intense topical working meetings
- o External Events
  - EU: France and Spain attempting to narrow to one EU site by Sept. 23
  - CA: Federal government deciding whether to reinstate fusion program and, if so, whether to develop a new robust site proposal by end of Sept.
- o (In Parallel) ITER Transitional Arrangements (ITA)
  - 'Shadow Council' (PC series)

## *Common Message from P1*

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- o Negotiations ongoing since November 2001 to develop an international agreement for ITER
- o High-level decision-making process needed; P meeting ideas
- o P Meetings discuss: site, key personnel, procurement allocation, and cost sharing, all in high-level, small groups
- o Work plan envisions agreement in Autumn, 2003
- o Negotiations could be concluded by turn of year
- o First P Meeting held in June, 2003, including KO, now 7 parties: CA, CN, EU, JA, KO, RF, and US
- o First indications of positions on key points shared
- o Substantial progress made toward implementation of ITER

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## *ITER Organization*

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- o OFES
  - Restructuring Office to have two Divisions
    - Research Division (John Willis)
      - Erol Oktay, US ITER Science Officer; Sam Berk, US ITER Technology Officer
    - ITER/International Division (Michael Roberts)
      - Warren Marton, US ITER Project Officer

## *ITER Organization* (continued)

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- o US Fusion Community
  - Presently have US ITER Planning Officer
    - Ned Sauthoff, PPPL, with Deputy--Charles Baker, UCSD
  - OFES to organize US ITER Project Office at existing institution
- o Internationally
  - International Team now headed by Yasuo Shimomura
  - OFES seeking nominees for Senior Management positions



Proposed<sup>+</sup>

# Office of Fusion Energy Sciences

**N. Anne Davies**

Associate Director of Science for Fusion Energy Sciences

**Al Opdenaker**

Executive Assistant  
Systems Studies, Budget

**Shahida Afzal**

Administrative Specialist (Personnel)

**Suellen Velthuis**

Visual Information Specialist

Princeton Area Office

**Jerry Faul**

Manager

Berkeley Area Office

**Mark Foster**

DIII-D Site Rep.

## Research Division

**John Willis, Director**

**Marty Carlin**, Administrative Specialist (Programmatic)

**T.J. Moore**

Administrative Specialist (Procurement)

**John Sauter**

Program Support Specialist

## ITER & International Division

**Michael Roberts, Director**

**Sandy Newton**, Administrative Specialist (International)

**Vacant**◆

Basic Plasma Science,  
IFE, University Liaison,  
IFE International, HEDP

**Curt Bolton**

Next Step Options, Theory  
Team Leader

**Michael Crisp**

Atomic Physics, Theory,  
HBCU

**Rostom Dagazian**

C-MOD, Theory

**Steve Eckstrand**

NSTX, SciDAC, Fusion  
Simulation Project, Compact  
Stellarator, NCSX

**Chuck Finfgeld**

University Tokamaks  
& Stellarators

**Darlene Markevich**

Diagnostics, Education,  
Outreach, ITER Diagnostics

**Erol Oktay**\*\*

DIII-D, International Tokamaks

**Francis Thio**

Exploratory Concepts (Alts)

**Sam Berk**\*\*

Technology Leader, VLT, PFC,  
Plasma Chamber Sys, Materials

**Gene Nardella**

Tritium and Safety, TSTA,  
NCSX Project Management,  
Fac. Ops/Expts/GPP & IFE  
Technology

**T.V. George**

Heating and Fueling,  
SBIR/STTR, Facility Upgrades

**Arnold Kritz**\*

Modeling and Simulation

**Ray Schwartz**‡

Fac. Ops/Expts, TSTA

**Warren Marton**◆

U.S. ITER Project Officer

**Debra Frame**

Administration

**Erol Oktay**\*\*

ITER Science Officer

**Sam Berk**\*\*

ITER Technology Officer

◆Principal Acting Director

\*IPA (Lehigh Univ.)

\*\*Dual Capacity

‡On Call from SC-80

( ) Area of Emphasis

<sup>+</sup>Does not necessarily reflect formal organization or position descriptions

# *Principles for Charter of U.S. ITER Project Office*

DRAFT

## *to be Established for ITER Construction*

DRAFT

1. DOE will select an Institution to house the US ITER Project Office, which will work closely with OFES in implementing its duties.
2. Using the principles contained in this list a charter will be developed between the Institution and the Associate Director, FES for the conduct of the US ITER Project Office.
3. The Institution will provide for the service of key people to lead and staff this Office.
4. DE will retain the right of concurrence/consultation on these key personnel assignments.
5. The Institution will incorporate individuals from the US fusion community to ensure a national, multi-institutional approach to this Office.
6. The Institution will provide the necessary administrative services, such as procurement, legal and financial activities.
7. The Institution will establish an advisory structure to assure community engagement and appropriate oversight of all aspects of the Office.
8. The US ITER Project Office will manage all aspects of the contributions made by the US to the ITER Organization, including secondment of US personnel.
9. For those components provided on an in-kind basis, the Office will act as the US project manager, working in close coordination with the performers.
10. For those components provided through contracts made directly with the ITER Organization, the Office will act as the US contact.
11. The Office, working closely with OFES, will coordinate the US fusion scientific activities conducted in support of the ITER Construction and preparation for operation.
12. The Office will represent the US in all technical and managerial meetings at the working level, support the DOE representatives as appropriate.
13. The Office and the Institution will be held accountable for the technical, cost and schedule achievements associated with the US contributions to the ITER Organization and for compliance with appropriate DOE project management requirements.
14. Periodic external reviews, organized by the DOE, will be made of the Office's and Institution's performance.

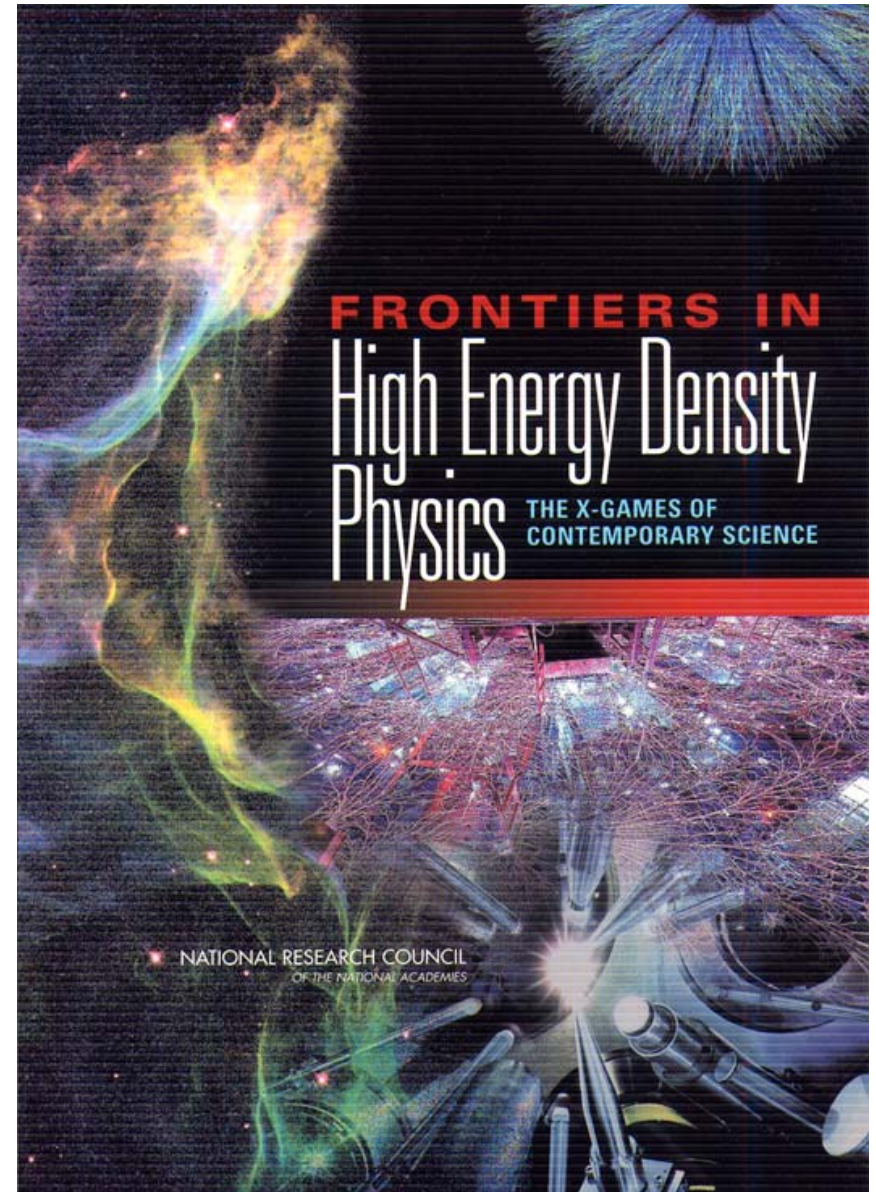
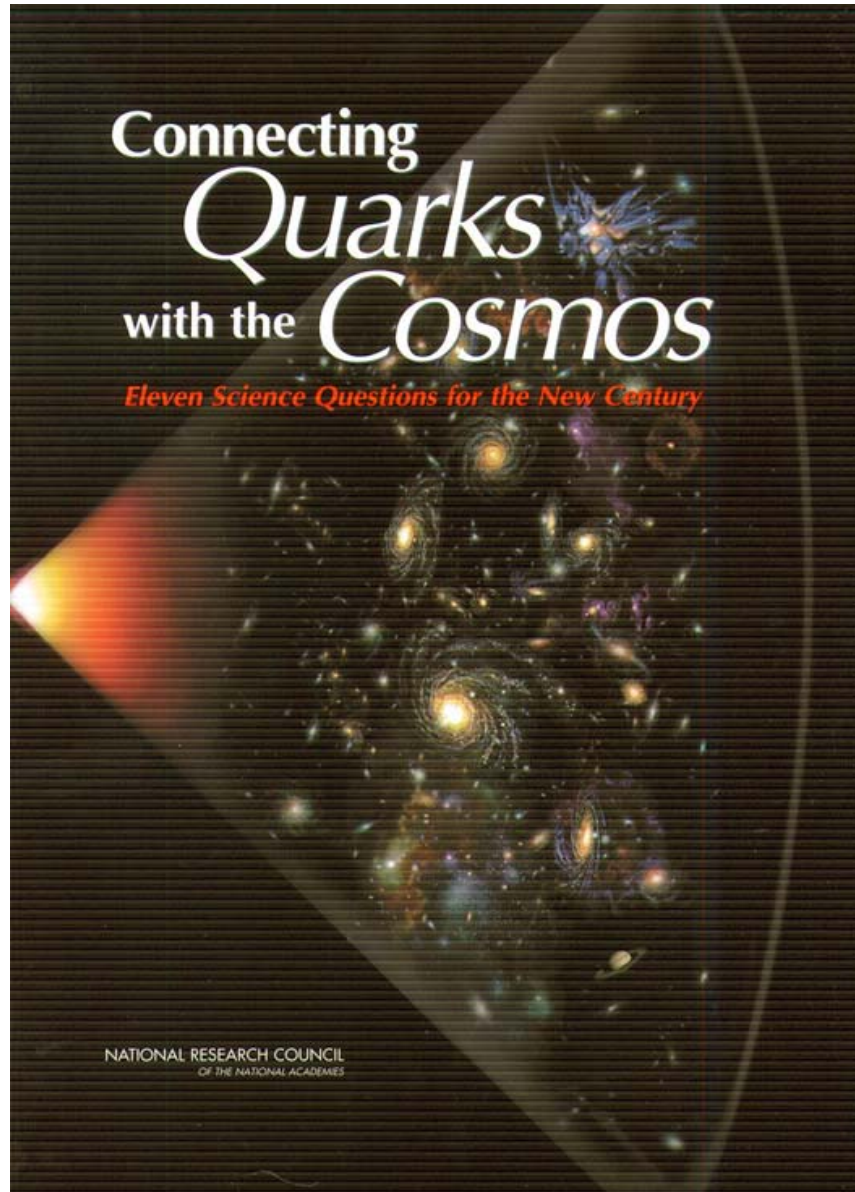
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# *National Research Council Reports*

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## *NRC Report on Burning Plasma Strategy*

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- o Pre-publication draft available in October
- o Final report published December 2003



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## *OMB Program Assessment Rating Tool (PART)*

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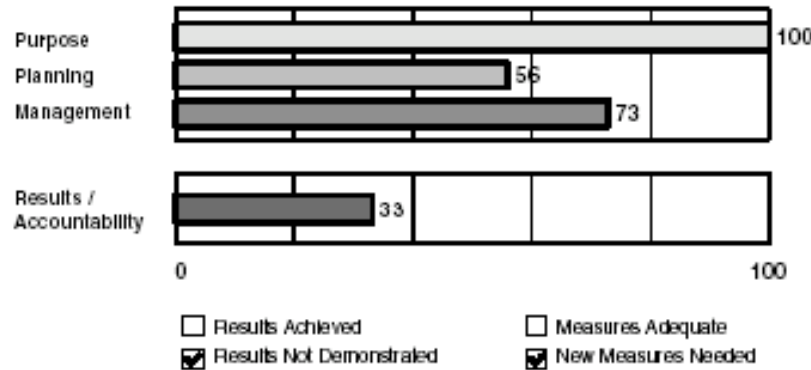
- o System used by OMB to grade program performance
- o Requires clear evidence with references to support positive grade on each element rated

# FY 2004 FES PART Summary

**Program:** Fusion Energy Sciences

**Agency:** Department of Energy

**Bureau:** Office of Science



*Key Performance Measures*      *Year*    *Target*    *Actual*

<i>Key Performance Measures</i>	<i>Year</i>	<i>Target</i>	<i>Actual</i>
Long-term Measure: Measures under development			
Annual Measure: Measures under development			

**Rating:** Results Not Demonstrated

**Program Type:** Research and Development

**Program Summary:**

The Office of Science's Fusion Energy Sciences (FES) program supports facilities and research in plasma science, fusion science, and fusion technology aimed at providing the intellectual basis for a future fusion energy source of commercial power.

The program received a perfect score in the purpose section and a fairly high score in the management section, mainly as a result of standard management practices within the Office of Science that lead the FES program to have a well defined mission, merit-based reviews for awarding contracts and grants, and highly-regarded large project management practices. The primary cause for the lower scores for planning and results is the program's current lack of adequate long-term and annual performance measures. Nevertheless, the program has made significant strides toward developing such measures despite the problems inherent in predicting and then measuring scientific progress. Other findings include:

1. The program delivers projects on cost and schedule; including its most recent construction project, the National Spherical Torus Experimental Facility, and its current decontamination and decommissioning project for the Tokamak Fusion Test Reactor.
2. The program receives a significant amount of external expert assessments of its research and program management strategies.
3. The program budget is not sufficiently aligned with program goals so that the impact of funding changes on performance is readily known, and so that basic research elements are distinguished from applied research elements.

To address these findings:

1. The 2004 Budget provides funds to operate the program's user facilities at 84 percent of maximum capacity (the same as in 2003 and 39 percent more than in 2002).
2. The Administration will work to reform its performance measures and goals, understanding the difficulties that basic research programs face in attempting to predict future scientific progress.
3. The Department will work to further clarify the relationship between the program goals and budget.

(For more information on this program, please see the Department of Energy chapter in the Budget volume.)

*Program Funding Level (in millions of dollars)*

<u>2002 Actual</u>	<u>2003 Estimate</u>	<u>2004 Estimate</u>
247	257	257



# Sample of PART Worksheet

## OMB Program Assessment Rating Tool (PART)

### Research & Development Programs

Name of Program: Fusion Energy Sciences

#### Section I: Program Purpose & Design (Yes, No, N/A)

	Questions	Ans.	Explanation	Evidence/Data	Weighting	Weighted Score
1	Is the program purpose clear?	Yes	The mission of the Fusion Energy Sciences (FES) program is to advance basic research in plasma and fusion science, including burning plasma behaviors, confinement theories and strategies, and associated advanced materials, supporting the long-term DOE goal.	FY04 Budget Request. Public Law 95-91 that established the Department of Energy (DOE).	20%	0.2
2	Does the program address a specific interest, problem or need?	Yes	FES goals are, for Magnetic Fusion (MFE): 1. Advance the fundamental understanding of plasma and enhance predictive capabilities, through the comparison of well-diagnosed experiments, theory and simulation. 2. Resolve outstanding scientific issues and est	The FY04 Budget Request. National Research Council (NRC) report "Plasma Science". Fusion Energy Sciences Advisory Committee (FESAC) "Report on the Integrated Program Planning Activity for the DOE Fusion Energy Sciences Program" ( <a href="http://www.ofes.fusion.doe.gov">www.ofes.fusion.doe.gov</a> )	20%	0.2
3	Is the program designed to make a unique contribution in addressing the interest, problem or need (i.e., not needlessly redundant of any other Federal, state, local or private efforts)?	Yes	FES is unique in funding research in magnetic fusion research for energy purposes. The program is coordinated with NNSA IFE program. FES also provides support for research in plasma science, and is coordinated with the National Science Foundation (NSF)	FES supports nearly 90% of Plasma Physics research in the U.S., with most of the remainder being supported by NSF and the NNSA. Joint Program plans with NNSA. Joint solicitations with NSF.	20%	0.2
4	Is the program optimally designed to address the interest, problem or need?	Yes	The FES program is based on competitive merit-review, independent expert advice, and community planning. This proves efficient and effective.	FESAC reviews and reports. Program files.	20%	0.2
5 (RD 1)	Does the program effectively articulate potential public benefits?	Yes	While focused on basic research goals, FES also advances technologies that impact: energy, industry, computing and other areas of research.	Recent benefits are in the FY04 Budget Request. Historic Benefits ( <a href="http://www.ofes.science.doe.gov/FusionDocs.htm">www.ofes.science.doe.gov/FusionDocs.htm</a> ).	20%	0.2
6 (RD 2)	If an industry-related problem, can the program explain how the market fails to motivate private investment?	N/A	The program is not industry related.		0%	
<b>Total Section Score</b>					<b>100%</b>	<b>100%</b>

# *OFES Performance Measures*

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## **Long Term Indicators**

### **Predictive Model for Burning Plasmas**

Develop a predictive model for key aspects of burning plasmas using advances in theory and simulation benchmarked against a comprehensive experimental database of tokamak stability, transport, particle interaction, and edge effects.

### **Alternates**

Demonstrate enhanced fundamental understanding of magnetic confinement and improved basis for future burning plasma experiments through research on alternative magnetic confinement configurations.

### **High Energy Density Physics/IFE**

Demonstrate that new physical phenomena have resulted from using high energy beams and lasers to explore extreme states of matter.

### **Materials**

Develop and validate a portfolio of multi-scale radiation damage models that includes production, migration, and clustering of irradiation defects and their resultant effects on material properties.

## ***OFES Performance Measures*** (continued)

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### **FY 2005 Targets**

#### **Facility Operations**

Average unscheduled downtime of the major national fusion facilities as a percentage of the total scheduled annual operating time.

#### **FY 2005 Construction**

Cost-weighted mean percent variance from established cost and schedule baselines for major construction, upgrade, or equipment procurement projects.

## ***JOULE Milestone Tracking System***

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- o For the Deputy Secretary
- o Provides tracking of progress toward annual targets
- o The annual targets are displayed in the yearly budget narrative that is sent to Congress
- o The Director of SC meets quarterly with the Deputy Secretary to report on quarterly milestones
- o The “grade” received by OFES affects the “grade” given to SC



**Key Performance Areas – SC – Second Quarter, FY 2003  
(Breakdown by Program Goals)**

<ul style="list-style-type: none"> <li>■ High Energy Physics (SC1) <ul style="list-style-type: none"> <li>■ Experimental Research Program (SC1-1) *</li> <li>■ Antimatter in the Universe (SC1-2) *</li> <li>■ User Facilities Crosscut (SC7-1) *</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>■ Nuclear Physics (SC2) <ul style="list-style-type: none"> <li>■ Nucleon Structure (SC2-1) *</li> <li>■ Hot Dense Nuclear Material (SC2-2)</li> <li>■ Nuclei Stability (SC2-3) *</li> <li>■ User Facilities Crosscut (SC7-2) *</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>■ Biological and Environmental Research (SC3) <ul style="list-style-type: none"> <li>■ Biotechnology Solutions (SC3-1) *</li> <li>■ Greenhouse Gases and Aerosols (SC3-2)</li> <li>■ User Facilities Crosscut (SC7-3)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>■ Basic Energy Sciences (SC4) <ul style="list-style-type: none"> <li>■ Leading BES Research Programs (SC4-1)*</li> <li>■ Leadership in Nanoscale Science (SC4-2)*</li> <li>■ X-Ray Diffraction (SC4-3) *</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>■ <b>Advanced Scientific Computing (SC5)</b> <ul style="list-style-type: none"> <li>■ Leading ASC Research Programs (SC5-1)</li> <li>■ GRID Middleware Assessment (SC5-2) *</li> <li>■ User Facilities Crosscut (SC7-5)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>■ <b>Fusion Energy Sciences (SC6)</b> <ul style="list-style-type: none"> <li>■ Magnetically Confined Plasma/Tokamak Concept (SC6-1)</li> <li>■ Cutting Edge Technologies in Fusion Energy Sciences (SC6-2) *</li> <li>■ <sup>1</sup> User Facilities Crosscut (SC7-6) *</li> </ul> </li> </ul>

## *Project Assessment and Reporting System (PARS)*

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- o Internal, central DOE project management and reporting system
- o Reporting to the Office of Engineering and Construction Management, independent DOE project organization
- o Covers all projects at or beyond Critical Decision 1 (CD1)
- o Federal Project Managers report project status on a monthly basis
- o Currently NCSX is in the system
- o QPS will be if it reaches CD1

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## *New Charges*

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- o Inertial Fusion Energy
  - Assess present status of the IFE program
  - Early 2004
- o Workforce Development
  - Does the current system of education and training of scientists and engineers assure the workforce needed in the future?
  - January 31, 2004
- o Target and Indicators (Performance Measures)
  - Are the program's long-term and annual performance measures appropriate and sufficiently ambitious
  - August 15, 2003

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## *Committee of Visitors*

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- o Modeled on the NSF approach
- o Prototyped for SC by BES
- o Plan to use FESAC Panels
- o Program Areas to be reviewed include
  - Theory
  - Innovative Confinement Concepts
  - Diagnostics
- o Each panel will review process and results of process