



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

Fusion Energy Sciences Program Update

Fusion Energy Sciences Advisory Committee



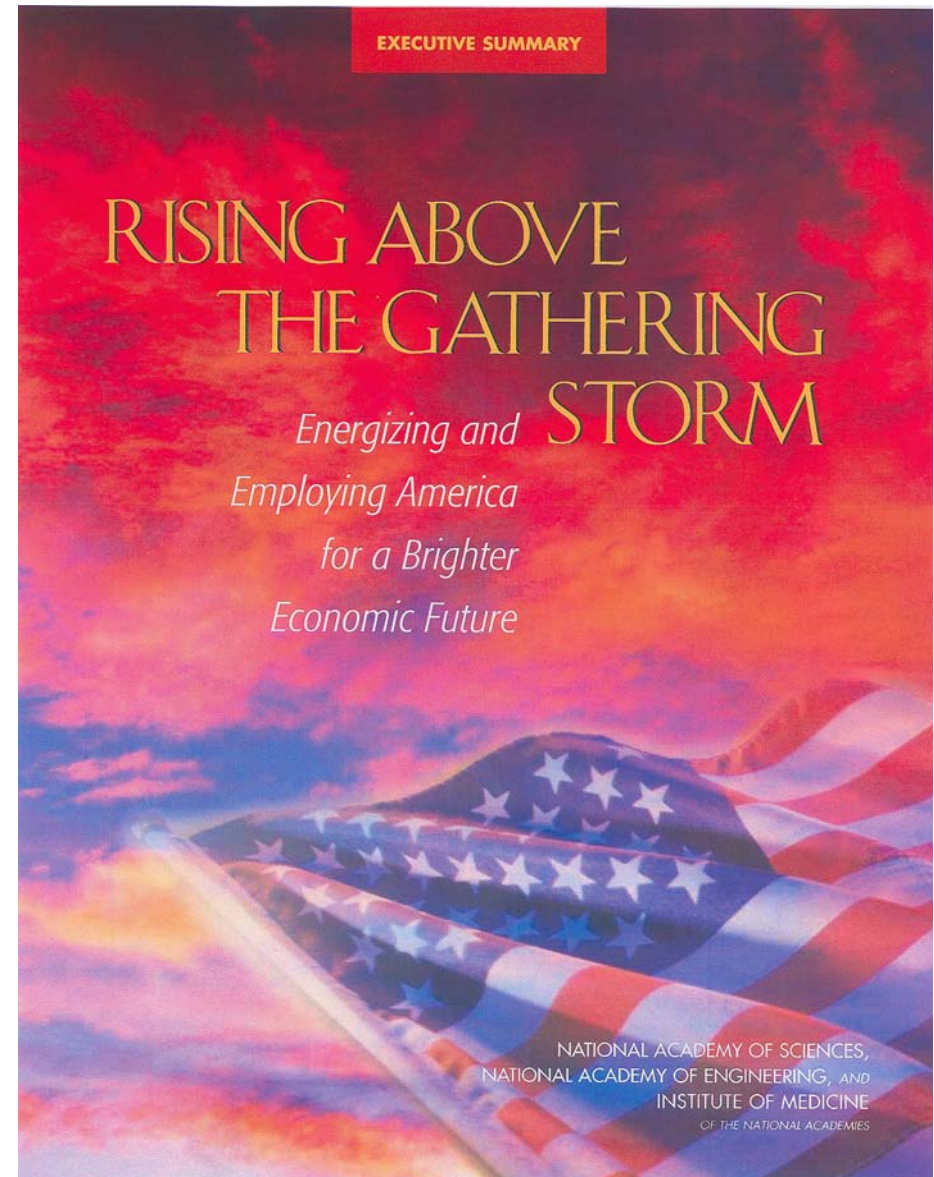
Dr. N. Anne Davies
Associate Director
for Fusion Energy Sciences

www.ofes.fusion.doe.gov

February 28, 2006

National Academy of Sciences Report

Fusion is part of
SC's part of the
American
Competitiveness
Initiative





Office of Science

FY 2007 Congressional Budget Request

(dollars in thousands)

	FY 2005 Approp.	FY 2006 Approp.	FY 2007 President's Request	FY 2007 vs. FY 2006
Basic Energy Sciences.....	1,083,616	1,134,557	1,420,980	+286,423
Advanced Scientific Computing Research.....	226,180	234,684	318,654	+83,970
Biological and Environmental Research				
Base program.....	487,474	451,131	510,263	+59,132
Congressional-directed projects.....	79,123	128,700	—	-128,700
Total, Biological and Environmental Research.....	566,597	579,831	510,263	-69,568
High Energy Physics.....	722,906	716,694	775,099	+58,405
Nuclear Physics.....	394,549	367,034	454,060	+87,026
Fusion Energy Sciences.....	266,947	287,644	318,950	+31,306
Science Laboratories Infrastructure.....	37,498	41,684	50,888	+9,204
Science Program Direction.....	154,031	159,118	170,877	+11,759
Workforce Development for Teachers and Scientists.....	7,599	7,120	10,952	+3,832
Small Business Innovation Research/Technology Transfer.....	113,621	—	—	—
Safeguards and Security.....	67,168	68,025	70,987	+2,962
Subtotal, Science.....	3,640,712	3,596,391	4,101,710	+505,319
Use of prior year balances.....	-5,062	—	—	—
Total, Science.....	3,635,650	3,596,391	4,101,710	+505,319

FY 2007 Fusion Energy Sciences Congressional Budget Request

	(\$ Millions)		
	FY 2005	FY 2006	FY 2007
	<u>Actual</u>	<u>Appropriations</u>	<u>Request</u>
Science	148.5	156.9	154.2
Facility Operations	89.7	103.5	121.6
Enabling R&D	<u>28.7</u>	<u>27.2</u>	<u>43.2</u>
OFES Total	266.9	287.6	319.0
DIII-D	55.8	54.7	56.7
C-Mod	22.0	21.7	22.8
NSTX	34.5	34.0	35.1
NCSX	18.3	17.8	16.6
ITER	5.4	25.1	60.0
Non-ITER	261.5	262.5	259.0

FY 2007 Fusion Program Highlights

- o Continue U.S. ITER Fabrication Effort (\$60.0M, +\$34.9M)
 - \$37.0M for MIE Project (Total Estimated Cost funding)
 - \$23.0M for R&D support (Other Project Costs funding)

ITER Outyear Funding Profile

U.S. Contributions to ITER - Annual Profile

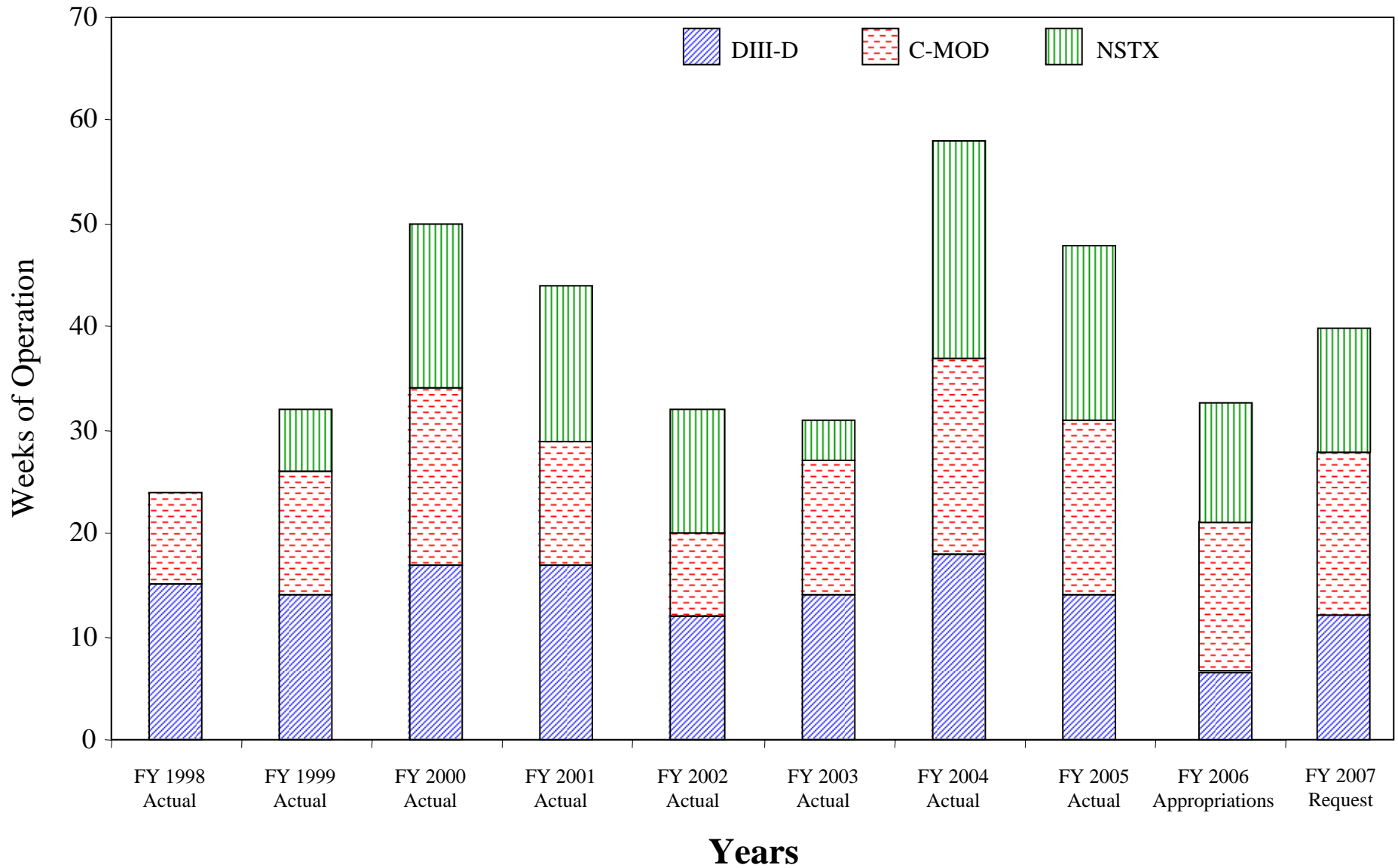
(\$ in Millions – in as spent dollars)

<u>Fiscal Year</u>	<u>Total Estimated Costs (TEC)</u>	<u>Other Project Costs (OPC)</u>	<u>Total Project Costs (TPC)</u>
2006	15.9	3.4	19.3
2007	37.0	23.0	60.0
2008	149.5	10.5	160.0
2009	208.5	6.0	214.5
2010	208.5	1.5	210.0
2011	180.8	.5	181.3
2012	130.0	0	130.0
2013	116.9	0	116.9
2014	30.0	0	30.0
Total	1,077.1	44.9	1,122.0

FY 2007 Fusion Program Highlights (continued)

- o **Increase Major Facility operations and research** (+\$4.2M)
 - 12 weeks on DIII-D, 15 weeks on C-Mod, 12 weeks on NSTX

Major Fusion Facilities Operating Times



Major Facilities

<u>Funding (\$ in Millions)</u>	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
DIII-D	55.8	54.7	56.7
C-Mod	22.0	21.7	22.8
NSTX	<u>34.5</u>	<u>34.0</u>	<u>35.1</u>
Totals	112.3	110.4	114.6

- o The three facilities are the backbone of the U.S. Magnetic Fusion Program:
 - Provide opportunities to **~500 scientists** for fusion experiments;
 - Advance fusion scientific understanding of plasmas in the U.S. and provide a strong U.S. presence in international collaborations;
 - Give credibility to U.S. partnership in ITER.
- o In FY 2007, the total research and facility operations budget for the three facilities increases from **\$110.4M to \$114.6M**
 - DIII-D operations will increase from 7 weeks in FY 2006 to 12 weeks in FY 2007; C-Mod increases from 14 weeks to 15 weeks; NSTX from 11 weeks to 12 weeks.
 - Coordinated experiments on burning plasma physics and **ITER physics** support through the International Tokamak Physics Activity (ITPA) will have high priority
- o The U.S. will continue collaboration on foreign tokamaks for increased experimental opportunities.

FY 2007 Fusion Program Highlights (continued)

- o **Increase SciDAC** (+\$2.7M)
 - Includes two additional SciDAC projects

Scientific Discovery through Advanced Computing

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
Funding (\$ Millions)	4.0	4.3	7.0

- o Supports multi-disciplinary teams of computer scientists, applied mathematicians, and physicists to achieve scientific advances through computer simulations
- o Existing fusion SciDAC projects in the areas of **macroscopic stability, electromagnetic wave-plasma interaction, and turbulent transport** will be continued
- o Two fusion simulation prototype centers, initiated at the end of FY 2005 in the areas of **RF wave interactions with MHD, and the plasma edge** will continue developing components for integrated simulations
- o In FY 2007, projects focused on the development of **fusion collaboratories, integrated frameworks for fusion simulations**, and other scientific application partnership areas will join our SciDAC portfolio

FY 2007 Fusion Program Highlights (continued)

- o Reduce Innovative Confinement Concepts research (-\$1.8M)
- o Reduce HEDP research (-\$3.9M)
- o Reduce Theory (-\$1.0M)
- o Reduce NCSX funding per baseline plan (-\$1.1M)
- o Reduce Plasma Technologies to focus on ITER specifics (-\$1.3M)
- o Reduce fusion materials science research (-\$2.4M)

Innovative Confinement Concepts CE Program

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
Funding (\$ Millions)	21.7M	21.8M	20M
<u>Projects approximately 1M or more</u>			
Labs	7.1M	7.2M	6.7M
Non-Labs	6.5M	6.2M	5.6M
<u>Projects considerably less than 1M</u>			
Labs	1.01M	1.03M	0.95M
Non-Labs	6.2M	6.3M	5.8M
Other	0.79M	1.05M	0.7M

- o The reduction (8.4%) in FY 2007 will be taken uniformly across all projects
- o After 7 years of intensive review, the surviving crop of presently funded ICC CE projects have reviews rated in the Very-Good-to-Excellent range
 - Most are entering their second data gathering and analysis cycle
 - A major review of the program is planned for FY 2008/2009 time frame

HEDP

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
Funding (\$ Millions)	14.6	15.8	11.9

- o Research in fast ignition and plasma jets is reduced by \$1.8M
- o Research in heavy ions is reduced by \$1.1M
- o Research using the Atlas pulsed power facility is discontinued (\$1M)

Theory Program Summary

Funding (\$ Millions)	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
Labs	11.5	11.0	10.4
Non-Labs	<u>14.2</u>	<u>13.9</u>	<u>13.5</u>
Total	25.7	24.9	23.9

- o FY 2006 Theory solicitation resulted in 27 proposals with 13 being funding. FY 2007 Theory solicitation is currently underway
- o Reviewed PPPL theory program, and will review the LANL and LLNL theory programs this fiscal year
- o Created a partnership with OASCR to develop a continuum kinetic edge code, which will complement the Fusion Simulation Projects
- o FY 2007 funding reductions taken across the board

NCSX Project

Funding (\$ Millions)	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
MIE	17.5	17.0	15.9
MIE Research	<u>.8</u>	<u>.8</u>	<u>.7</u>
Total	18.3	17.8	16.6

- o A new baseline was established in July 2005 for NCSX that resulted in a 14-month delay in the schedule with completion in July 2009 and a new TEC of \$92,401,000. The FY 2007 request of \$15,900,000 supports this new baseline.

Enabling R&D

Funding (\$ Millions)	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
Plasma Technologies	18.4	14.2	12.9
Materials Research	7.3	7.1	4.7

- o Plasma Technologies develops the cutting edge technologies that enable both current and future U.S. and international fusion facilities to achieve their goals.
- o Materials Research is critical to establishing the environmental attractiveness of fusion
- o Both programs are being reduced to provide resources for ITER

Fusion Energy Sciences

(\$ in thousands)

Science	FY 2005 Sept AFP	FY 2006 Appropriations	FY 2007 Request	Enabling R&D	FY 2005 Sept AFP	FY 2006 Appropriations	FY 2007 Request
DIII-D Research	24,042	24,412	24,300	Engineering Research			
C-MOD Research	8,636	8,510	8,890	Plasma Technologies (MFE)	18,403	14,205	12,945
International Collaborations	5,116	4,826	5,064	Advanced Design & Analysis (MFE)	2,979	2,489	2,550
Diagnostics	3,894	3,763	3,854	Enabling R&D for ITER	0	3,449	23,000
Other	5,364	5,006	3,730	Materials Research (MFE)	7,338	7,043	4,687
SBIR/STTR (science)	0	6,945	7,262				
Subtotal Tokamaks	47,052	53,462	53,100	Enabling R&D Total	28,720	27,186	43,182
NSTX Research	15,992	15,845	16,696	Total Fusion Energy Sciences	266,947	287,644	318,950
Experimental Plasma Research	21,656	21,778	19,990				
HEDP	14,640	15,856	11,949	DIII-D	55,751	54,692	56,662
ATLAS	(0)	(990)	(0)	Alcator C-Mod	22,038	21,717	22,831
MST Research	6,423	6,320	6,970	NSTX	34,387	33,985	35,118
NCSX Research	773	751	697	NCSX	18,273	17,770	16,597
Subtotal Alternates Research	59,484	60,550	56,302	ITER (Preparations & MIE)	5,451	25,150	60,000
Theory	24,928	25,749	23,900	Non-ITER	261,496	262,494	258,950
Advanced Computing/SciDAC	4,033	4,222	6,970				
General Plasma Science	12,176	13,760	13,941				
Science Total	148,494	156,922	154,213				
Facility Operation							
DIII-D	31,709	30,280	32,362				
Alcator C-Mod	13,402	13,207	13,941				
NSTX	18,495	18,140	18,422				
NCSX	17,500	17,019	15,900				
Facility Ops times in weeks	16/18/18	7/14/11	12/15/12				
Other	1,433	1,298	2,020				
GPE	100	100	100				
GPP	1,643	1,791	1,810				
ITER Preparations	5,451	5,835	0				
U.S. Contributions to ITER (MIE)	0	15,866	37,000				
Facility Operations Total	89,733	103,536	121,555				

Representative Sherwood Boehlert (R-NY) During House Debate on 11/9/05

"I want to make clear to everyone concerned that I will do everything in my power to kill the ITER project if there is not an agreement by March that the domestic fusion program has to be scaled back to pay for ITER. I am not going to allow the U.S. to enter into an international commitment that it cannot afford. I would rather kill the ITER project. The fusion community will have to be realistic. It cannot have all its current projects and ITER. And it will not."

American Competitive Initiative and Earmarks

Funds provided in a tough federal budget must be used for relevant, peer reviewed research

Earmarks will be removed from agency budget in the next year

Outreach to S&T Communities

“... Most scientists funded by [OFES] do not actively participate in the wider scientific culture. As a result, the flow of scientific information out of and into the field is weak. ...Nor is the high-quality science in the program widely appreciated outside the field. Indeed, the broader scientific community holds a generally negative view of fusion science.”

- National Research Council's Assessment of the DOE's Office of Fusion Energy Sciences Program, 2001

The Secretary of Energy must submit to Congress a plan which ensures that “communication of scientific results and methods between the fusion energy science community and the broader scientific and technology communities is improved.”

- Energy Policy Act of 2005, Sec. 972(b)(1)(E)

Outreach to S&T Communities

- o All of fusion will benefit from greater communication with and respect from other areas of science and technology
 - No direct incentive for broader communities to initiate
 - Energy Policy Act requirement and a good idea
- o OFES will track
 - Number of presentations at local colleges, alma maters, and other universities
 - Collaborations with scientists outside of plasma physics
 - Talks at non-plasma specific science meetings
 - Attempts to publish in broader science journals
 - Rejections okay – data still useful
- o First annual report from major facilities, ICC, and Theory leaders to be presented at March 2007 budget planning meeting
- o Line in grants and cooperative agreements may be added

New Charge to FESAC

Evolution of the Fusion Energy Sciences Program



Department of Energy
Office of Science
Washington, DC 20585
February 27, 2006

2

Professor Stewart C. Prager, Chair
Fusion Energy Sciences Advisory Committee
Department of Physics
University of Wisconsin
1150 University Avenue
Madison, Wisconsin 53706

Dear Professor Prager:

For many years, the fusion program has benefited from international collaboration in all aspects of the program. With the advent of the ITER project, the program will achieve a new and unprecedented level of collaboration. Also, during the time before ITER operations begin, our ITER partners will be bringing a new suite of advanced tokamak facilities on line around the world. It is time for us to begin to plan for the transition to the operating phase of ITER, and, in so doing, assess how we can optimize our experimental physics program, considering all the facilities that will be available worldwide.


Therefore, I would like for FESAC to address an important set of issues: how the program should evolve over the coming decade to take into account new and upgraded international experiments and how the program should prepare to make the transition to ITER. Viewing the world fusion program as a fully integrated international endeavor rather than a series of national efforts, where will synergies, redundancies, and gaps in research arise, and how should the U.S. program adjust to minimize duplicate effort and fill important gaps? Should existing facilities remain in their current configurations, or should they be reconfigured to pursue the science of different concepts? Serious consideration should also be given to whether a point exists within the next 10 years when funds for any of the four major U.S. facilities may be better used for hardware and research on more capable facilities abroad.

FESAC has recently produced two comprehensive reports on the U.S. Magnetic Fusion Program, one titled "Scientific Challenges, Opportunities, and Priorities for the U.S. Fusion Energy Sciences Program" in December 2004, and the next titled "Characteristics and Contributions of the Three Major United States Toroidal Magnetic Fusion Facilities" in July 2005. These reports should provide a starting point for your work. This report should look strategically to the future, providing decision points and criteria for making those decisions. I will be able to provide budget guidance as soon as the Office of Science five-year budget is public. Given that funding will be finite, you will need to recommend priorities among the opportunities that you will identify.

This is an exciting time for the fusion program, a time for the fusion community to look forward with confidence that we will have a burning plasma experiment, as well as support for the balance of the program. It is also a time to reassess our portfolio of experiments and optimize what we are doing in the context of the world fusion program.

I would like to receive your report by the end of February 2007. Thank you for your time and your hard work.

Sincerely,


Raymond L. Orbach
Director

Associate Director Position Vacancy Information

To find out more information on the position for
[Associate Director for Fusion Energy Sciences](#)

Go to www.usajobs.opm.gov

Click on “**Search Jobs**”

In “**Keyword Search**” type in **Fusion**

At bottom of page, click “**search for jobs**”

Closing Date for application submission is March 31, 2006