



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

Fusion Energy Sciences Program

Fusion Energy Sciences Advisory Committee



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www.ofes.fusion.doe.gov

November 17, 2003

Topics

- o Budget Update
- o SC Facilities Plan
- o NRC Report/Response
- o ITER Negotiations
- o Performance Measures
- o Solicitations
- o NCSX Status
- o Fusion Simulation Project
- o HEDP/Q2C Reports/Response
- o Plasma Science Decadal Study
- o OFES Organization

FY 2004 Fusion Energy Sciences Budget

(\$ in Millions)

President's Request	257.3
Conference Report	264.1

in NNSA

High Average Power Laser Research	25.0
IFE Z-Pinch Studies	4.0
Petawatt Lasers	4.5

FY 2004 OFES Budget

Current Financial Plan Development

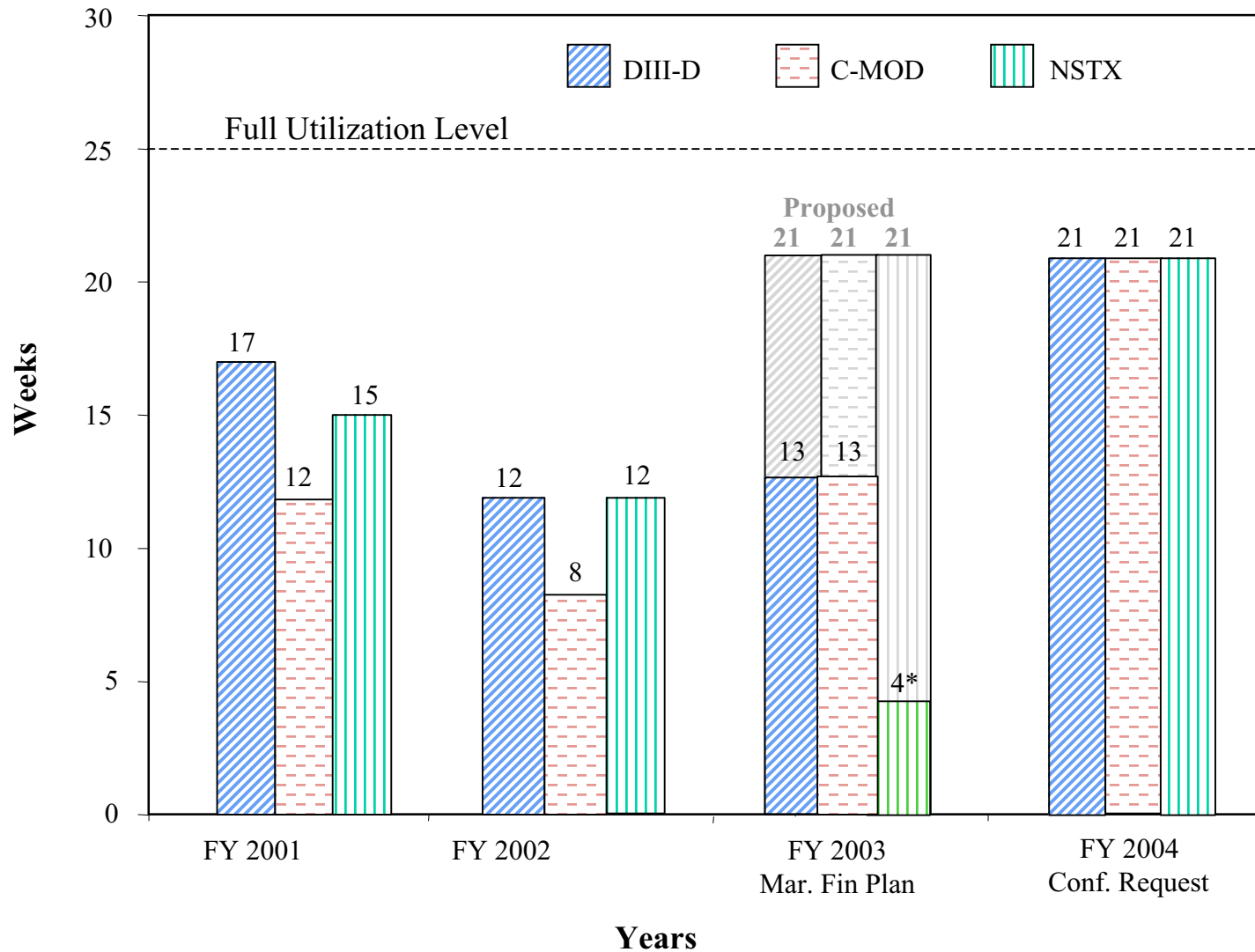
- o Principles
 - Minimize personnel disruptions
 - Increase operation of facilities over FY 2003 level as proposed (~21 weeks)
 - Support ITER Transitional Arrangements, modest effort on FIRE
 - Rebalance science and technology elements, to some extent
 - Continue NCSX project
 - Support for Fusion Science Centers Solicitations
 - Support National Lab portion of the successful NSF Science Center proposal led by University of Wisconsin
 - Partially restore cuts to International Collaborations

FY 2004 Fusion Energy Sciences Budget

(\$ in Millions)

	<u>FY 2004 Cong. Request</u>	<u>FY 2004 Conf. Report</u>
Science	138.1	140.6
Facility Operations	87.7	88.7
Technology	24.9	28.2
SBIR/STTR	<u>6.6</u>	<u>6.6</u>
<i>OFES Total</i>	<i>257.3</i>	<i>264.1</i>
DIII-D	56.7	56.7
C-Mod	22.7	22.7
NSTX	35.2	35.2
NCSX	16.7	16.7

Major Fusion Facilities Operating Times



*NSTX operating time was reduced due to the failure of one of the magnetic coils in February. Operations are expected to begin again in February 2004.

Office of Science

20 Year Facilities Plan



“These Department of Energy facilities are used by more than 18,000 researchers from universities, other government agencies, private industry and foreign nations.”

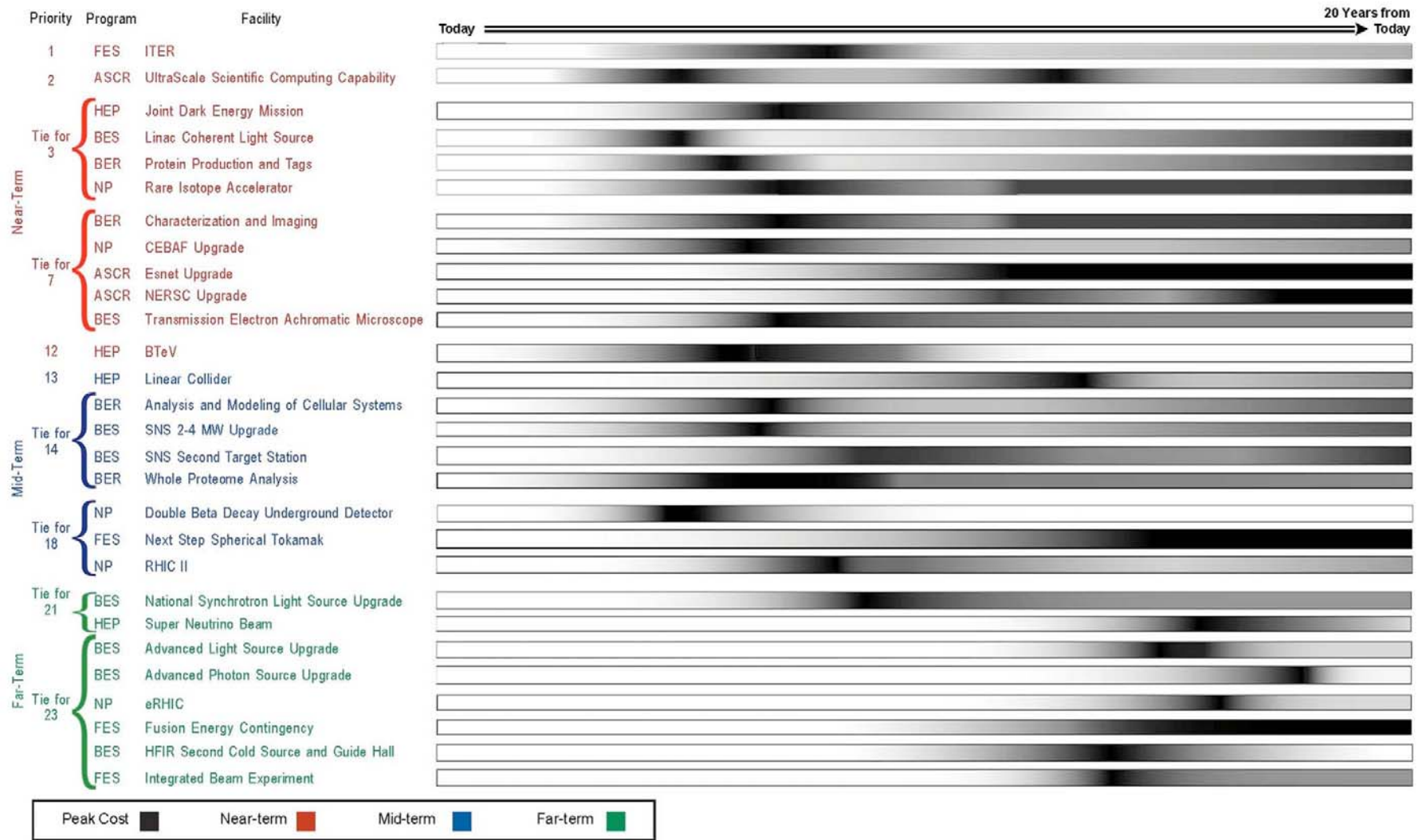
- Secretary of Energy
Spencer Abraham

The cover of the report 'Facilities for the Future of Science: A Twenty-Year Outlook' features a dark, starry space background. The title is in large white font. Below the title is the subtitle 'A Twenty-Year Outlook'. The cover is decorated with a vertical strip of ten small, framed images on the right side, each depicting a different scientific facility or concept. At the bottom left is the U.S. Department of Energy seal. To its right is the 'Office of Science' logo, which includes a stylized orange and red graphic and the text 'Office of Science' and 'U.S. DEPARTMENT OF ENERGY'. Below the logos is the date 'November 2003'.

Facilities
for the Future
of Science
A Twenty-Year Outlook

U.S. DEPARTMENT OF ENERGY
Office of Science
U.S. DEPARTMENT OF ENERGY

November 2003



Programs:
 ASCR = Advanced Scientific Computing Research FES = Fusion Energy Sciences
 BES = Basic Energy Sciences HEP = High Energy Physics
 BER = Biological and Environmental Research NP = Nuclear Physics

*Excerpts from Secretary of Energy Spencer
Abraham's Speech to the National Press Club*

November 10, 2003

“The prospect of a limitless source of clean energy for the world leads with our commitment to join the international fusion energy experiment known as ITER.

This is a Presidential priority with enormous potential. Successful negotiations among the international partners will lead to the first-ever fusion science experiment capable of producing a self-sustaining fusion reaction.

If we reach agreement, ITER will be our top facility.”

From the *Office of Science* 20 Year Facilities Plan

Facility Summaries

Near-Term Priorities

Priority: 1

ITER

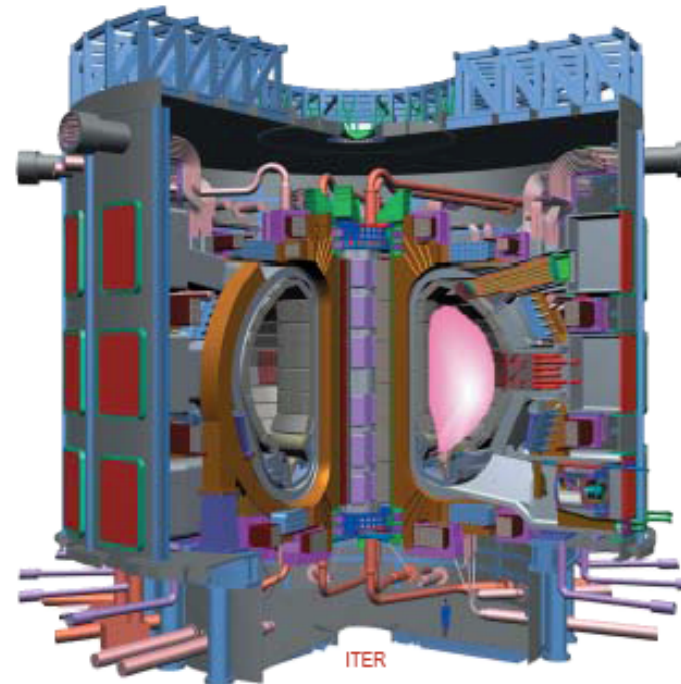
The Facility: ITER is an international collaboration to build the first fusion science experiment capable of producing a self-sustaining fusion reaction, called a "burning plasma." It is the next essential and critical step on the path toward demonstrating the scientific and technological feasibility of fusion energy.

Background: Fusion is the power source of the sun and the stars. It occurs when the lightest atom, hydrogen, is heated to very high temperatures forming a special gas called "plasma." In this plasma, hydrogen atoms combine, or "fuse," to form a heavier atom, helium. In the process of fusing, some matter is converted directly into large amounts of energy. The ability to contain this reaction, and harness the energy from it, are among the important goals of fusion research.

What's New: Recent advances in computer modeling and in our understanding of the physics of fusion give us confidence that we can now build ITER successfully. The unique features of the facility will be its ability to operate for

long durations (hundreds of seconds and possibly several thousands) and at power levels (around 500 MW) sufficient to demonstrate the physics of the burning plasma in a power-plant-like environment. ITER will also serve as a test-bed for additional fusion power-plant technologies.

Applications: ITER is the next big step toward making fusion energy a reality. Fusion energy is particularly attractive as a future energy source because it is environmentally benign (it produces no air pollution and no carbon dioxide, and it does not create long-lived radioactive waste); its fuels are easily extracted from ordinary water and from lithium, an abundant element; and it can be generated on demand and in sufficient capacity to power large cities and industries.



Report of the NRC Burning Plasma Assessment Committee

- o Burning Plasma: Bringing a Star to Earth released September 24, 2003
- o Reviewed only Magnetic Fusion Energy
- o Major Conclusions
 - Burning Plasma experiment needed to advance fusion science--join ITER but reassess and move ahead if ITER fails
 - Cannot be done with flat budgets, augmentation is required
 - Program should focus on realistic opportunities
 - Community should identify and prioritize program elements needed for a balanced program within the context of a program that includes ITER
 - ITER should be fully integrated into US Fusion Energy Sciences Program

FESAC Charge on Priority Setting

- o Identify major science and technology issues to be addressed in research campaigns through 2014
- o Prioritize the campaigns under three budget scenarios:
 - Current Level of \$257M plus OMB inflation rate
 - Level authorized in current draft of 2003 Energy Bill plus inflation for later years
 - Level midway between these profiles
- o Assume that U.S. participation in ITER construction is separate funding
- o Plan diversified program with ITER as part of an integrated whole
- o Include Inertial Fusion and relevant aspects of High Energy Density Physics

Energy Bill Profile

FY 2004	\$335M
FY 2005	\$349M
FY 2006	\$362M
FY 2007	\$377M
FY 2008	\$393M

Status of ITER Negotiations

- o Negotiations at many levels, ongoing since November 2001, to develop an international agreement for ITER
- o High-level decision-making process now established and working
- o Meetings discuss: site, key personnel, procurement allocation, and cost sharing, all in high-level, small groups
- o Negotiations planned for in-principle conclusion by end of the year
 - Wrap-up of legal agreement planned for first half of 2004
- o Provisional agreement reached on allocation of most procurement packages
 - Now checking for export control issues
- o Agreed on nominal top management structure
- o Accepted US introduction of Risk Management and Reserve ideas
- o Resolving most staffing concepts, enabling recruiting of most appropriate US people
- o Aim to agree on site and cost sharing this year

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.

OFES Performance Measures (continued)

FY 2005 Targets

Facility Operations

Average achieved operation time of the major national fusion facilities as a percentage of the total planned operation time. (*Efficiency Measure*)

FY 2005 Construction

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

Summary of 2003 Theory Solicitation

- o 39 proposals received
- o 18 proposals funded with total funding of ~\$6 M--all rated very good or better
- o 7 new PIs funded--good proposals combined with a modest growth in theory funding
- o 4 proposals get 4 year grants as a result of getting excellent rating by all reviewers and OFES theory team

ICC Review and Decision 2003: Summary

- o A total of 39 proposals were reviewed (12 of which are for renewals)
- o Based upon the reviews, the proposals are ranked in bands as “equals”
(Blue – funded), Green – limited funding, Red – Not funded)

	Non National Labs	National Labs
“Excellent”	3 renewals	1 renewal, 1 new
“Very-Good-to-Excellent”	5 new	3 renewals
“Very Good”	3 renewals	1 new
“Good-to-Very-Good”	2 new	2 renewals (1 yr)
“Good”	8 new	1 new
“Poor”	2 renewals (closeouts), 8 new	

- o Clearly there are opportunities for more funding
- o More details are available at the ICC Community Meeting after the UFA

Fusion Science Center (FSC) Initiative

Recommendation of the National Research Council Report “An Assessment of the Department of Energy’s Office of Fusion Energy Sciences Program”

- o *“Several new centers, selected through a competitive peer-review process and devoted to exploring the frontiers of fusion science, are needed for both scientific and institutional reasons.”*
- o Strong educational component
- o Centers should sponsor multidisciplinary workshops and summer school

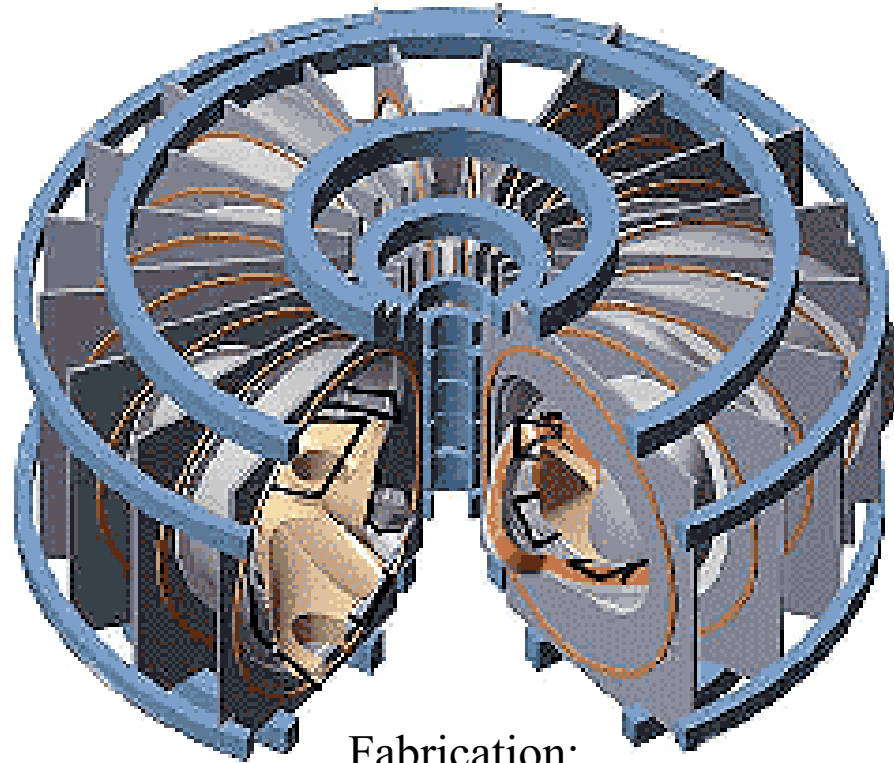
FSC Initiative Description

- o Focus of Center is on areas of fundamental importance to Fusion Plasma Science
- o \$2 Million in FY 2004 Funding for FSC
 - Host institution is expected to provide at least 15% cost sharing
 - Center expected to host workshops and summer schools
- o Grant duration of 5 years with possible 5 year renewal
- o Center will be a University based Center of Excellence with possibility of up to 20% of funding going to a National Laboratory(s) partner

Phased Review Process

- o Federal Register Notice in August 15, 2003
- o October 15, 2003 Letter of Intent Requested, but not required
- o November 15, 2003 receipt of Preliminary Applications for review by panel
- o January 15, 2004 Full Applicants are selected from Preliminary Applications
- o March 1, 2004 Deadline for receipt of Full Applications
- o April, 2004 Panel Review of Full Applications, including oral presentation by proposed key FSC participants
- o May 2004 FSC Awards

National Compact Stellarator Experiment (NCSX)



Fabrication:
FY 2003-2007

Partnership between
Princeton Plasma Physics Laboratory and Oak Ridge National Laboratory

National Compact Stellarator Experiment (NCSX)

- o Project started on April 1, 2003. Delayed 6 months due to the FY 2003 continuing resolution
- o NCSX Stellarator Core Systems (i.e. Modular coils, vacuum vessel) are technically challenging. Industry involved early in project for these critical systems
- o Project has completed (10/7-9/03) an independent review to determine whether the project was ready to establish its performance baseline cost and schedule (Critical Decision 2) and proceed to final design. The review team concluded it was ready
- o Current project proposal is to complete construction in September of 2007 at a cost of \$81M
- o DOE will now conduct (week of November 16) its reviews (Lehman review and Office of Engineering Construction Management External Independent Review) to determine whether we believe the project is ready to be baselined

Initiation of Fusion Simulation Project (FSP)

- o FESAC identified comprehensive simulation capability as a critical program element for the future
- o FSP – complex project with challenging goals
 - Planning FSP in advance of project initiation is essential
- o Planning committee appointed
 - 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)
 - Provide initial planning for implementation of FSP
 - Consider issues of organization and management structure
- o Committee will seek broad input from fusion, applied math and computer science communities
- o FSP will be a multi-institutional community project
 - Fraction of funding at a single institution will be limited

***Center for Magnetic Self-Organization
in Laboratory and Astrophysical Plasmas at U. Wisconsin-Madison***

- o An NSF Physics Frontier Center, a partnership with OFES
- o Goal: advance physics of magnetic self-organization common to laboratory plasmas and astrophysics
- o Teams laboratory plasma physicists and astrophysicists
- o Involves 4 experiments (MST, MRX, SSPX, SSX)
- o Involves theorists, computation scientists, and astrophysicists at Chicago, Princeton, SAIC, UW

Focused Materials Workshop

Can DOE establish a better strategy for developing materials for use in a harsh radiation environment?

- o ORNL is organizing a Fission-Fusion International Workshop for the Spring 2004 to address this question and develop a roadmap
- o Objective is to determine if the combination of advances in high-end computing with existing (i.e. fission reactors) and near term (i.e. spallation neutron source) facilities, can lead to development of reliable and experimentally validated modeling and simulation tools for the design and performance of advanced nuclear materials
- o This workshop will bring together an outstanding group of both domestic and foreign material and modeling/computing experts. Many experts will be from outside of the world's fusion community

High Energy Density Physics (HEDP)

- o Two NRC studies (Turner's "Connecting Quarks with the Cosmos", Davidson's "Frontiers in High Energy Density Physics") urge a national, multi-agency program in HEDP
 - An emerging field amenable to laboratory studies relevant to interpreting astrophysical observations and other applications of national importance
- o NSF is leading an interagency working group to develop a science driven roadmap for a balanced, comprehensive program in HEDP
- o NNSA plans to construct two high-energy petawatt (HEPW) lasers at Omega, and seeking to implement HEPW capabilities at Z and NIF without impacting the NIF schedule
- o DOE and NSF are called upon to strengthen the university activities in the HEDP field
- o OFES plans to respond by emphasizing the HEDP connections in its current IFE program

Possible Statement of Work for NRC Study

1. Assess the progress and achievements of plasma science over the past decade.
2. Identify the new opportunities and the compelling science questions for plasma science, frame the outlook for the future, and place the field in the context of physics as a whole.
3. Identify the compelling issues of plasma physics--as well as the technological challenges--relevant to fusion science.
4. Evaluate opportunities for the technological application of plasma science including potential applications to other fields.
5. Offer guidance to the government research programs and the scientific communities aimed at realizing these opportunities and challenges.

Office of Fusion Energy Sciences

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**Dual Capacity
() Area of Emphasis

+Does not necessarily reflect formal organization or position descriptions

We Need Help!!!!

Are you or somebody you
know willing to come to the
Office of Fusion Energy
Sciences as an IPA
appointment for 1-2 years?