April 5, 2005

Professor Richard D. Hazeltine, Chair
Fusion Energy Sciences Advisory Committee
The University of Texas at Austin
Institute for Fusion Studies
1 University Station, C 1500
Austin, TX 78712-0262

Dear Professor Hazeltine:

As you know, the Administration developed the Program Assessment Rating Tool (PART), comprised of assessment criteria on program performance and management. The Department, in conjunction with FESAC, produced the three long-term (FY 2015) PART performance measures for the Fusion Energy Sciences program in 2003, listed in Enclosure 1. The roadmap of objectives and performance targets toward the long-term PART measures is shown in Enclosure 2.

An independent, expert panel must conduct a review and rate the program's progress toward achieving the long-term PART measures on a triennial basis. I would like FESAC to conduct this review. As outlined in Enclosure 1, please rate the progress on each of the three long-term PART measures as excellent, minimally effective, or insufficient, including the rationale for your ratings. Please use the short and intermediate-term milestones from FY 2005 to FY 2009 shown in Enclosure 2 for Burning Plasma; Fundamental Understanding; Configuration Optimization; Materials Components, and Technologies; and Future Facilities as a guide in assessing the program's progress toward achieving the three long-term PART measures.

If FESAC believes that the program is not making adequate progress toward any of the three long-term (FY 2015) measures, please recommend how the program's performance could be improved.

Please send me your report by the end of January 2006.

Sincerely,

/s/

Raymond L. Orbach
Director
Office of Science

Enclosures:
1. (1) PART Performance Measures
2. (2) Roadmap of Objectives and Performance Targets

FESAC Panel

to review and rate the Fusion Energy program's progress toward achieving the long-term Program Assessment Rating Tool (PART) measures.

Gerald Navratil, Chair	Columbia
Ed Thomas	Auburn
Cynthia Phillips	PPPL
Martin Greenwald	MIT
Bill Nevins	LLNL
Grant Logan	LBL
Ray Fonck	U.Wisc
Scott Parker	U.Colorado
François Waelbroeck	U.Texas-IFS

Enclosure 2

Office of Management and Budget
Program Assessment Rating Tool (PART)
Long Term Measures for Fusion Energy Sciences

- **Predictive Capability for Burning Plasmas** - By 2015, demonstrate 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.

  - Definition of "Excellent" – Predict with high accuracy and understand major aspects relevant to burning plasma behavior observed in experiments prior to full operation of ITER.

  - Definition of "Good" – Validate predictive models against the database for some important aspects relevant to burning plasma physics (e.g. energetic particles, instabilities, control of impurities, etc…)

  - Definition of "Fair" – Validate predictive models against the database for a few aspects relevant to burning plasma physics (e.g. energetic particles, instabilities, control of impurities, etc…)

  - Definition of "Poor" – Achieve only limited success in improving models and validating them against the database.

  - How will progress be measured? – Expert Review every three years will rate progress as "Excellent," "Good," "Fair," or "Poor."

- **Configuration Optimization** – By 2015, demonstrate enhanced fundamental understanding of magnetic confinement and in improving the basis for future burning plasma experiments through research on magnetic confinement configuration optimization.

  - Definition of "Excellent" – Resolve key scientific issues and determine the confinement characteristics of a range of innovative confinement configurations.

  - Definition of "Good" – Develop understanding of the key scientific issues for several innovative magnetic confinement configurations currently under investigation.

  - Definition of "Fair" – Develop understanding of the scientific issues for a limited number of innovative magnetic confinement configurations currently under investigation.

- 0 Definition of "Poor" – Achieve little progress towards understanding the scientific issues concerning innovative magnetic confinement configurations.

- 0 How will progress be measured? – Expert Review every three years will rate progress as "Excellent," "Good," "Fair," or "Poor."

0 **Inertial Fusion Energy and High Energy Density Physics** – By 2015, demonstrate progress in developing the fundamental understanding and predictability of high energy density plasma physics, including potential energy-producing applications.

- 0 Definition of "Excellent," – Develop experimentally-validated theoretical and computer models, and use them to resolve the key physics issues that constrain the use of inertial fusion energy drivers in future key integrated experiments needed to understand the scientific issues for inertial fusion energy and high energy density physics.

- 0 Definition of "Good," – Use experimental data to develop understanding of the key physics issues that constrain the use of inertial fusion energy drivers in future key integrated experiments needed to resolve the scientific issues for inertial fusion energy and high energy density physics.

- 0 Definition of "Fair," – Use experimental data to develop a limited understanding of the key physics issues that constrain the use of inertial fusion energy drivers in future key integrated experiments needed to resolve the scientific issues for inertial fusion energy and high energy density physics.

- 0 Definition of "Poor," – Achieve little progress in understanding the key physics issues that constrain the use of inertial fusion energy drivers in future key integrated experiments needed to resolve the scientific issues for inertial fusion energy and high energy density physics.

- 0 How will progress be measured? – Expert Review every three years will rate progress as "Excellent," "Good," "Fair," or "Poor."

Ten Year Goals for Fusion Energy Sciences

- **Predictive Capability for Burning Plasma**: Progress toward 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

- **Configuration Optimization**: Progress toward demonstrating enhanced fundamental understanding of magnetic confinement and improved basis for future burning plasma experiments through research on magnetic confinement configuration optimization

- **High Energy Density Plasma Physics**: Progress toward developing the fundamental understanding and predictability of high energy density plasma physics

Goals and Milestones

Burning Plasma

- _ Establish the Department's role in ITER **(2005) INTL**
- • Begin U.S. contribution to ITER for this international collaboration to build the first fusion burning plasma experiment capable of a sustained fusion reaction **(2006) INTL**
- • Continue vendor qualification for long lead procurements for ITER in the area of superconducting strand and jacket materials **(2006)**
- • Refine theoretical and experimental understanding of transport, stability, wave-particle interactions, and edge effects in tokamaks **(2009)**
- • Initiate design and fabrication of the first test blanket module to be installed on ITER **(2011) BES**
- • Evaluate discharge scenarios for ITER based on major tokamak results **(2012)**
- • Begin ITER operation **(2014) INTL**
- o Progress toward 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 **(2015)**

_ = Key Intermediate Objective from DOE Strategic Plan
o = Long Term Success Measure from PART
INTL = with international community on ITER
BES = with BES on nano-designed materials
NNSA = with NNSA
Interdependencies: Broadly with **ASCR** on computational developments, both hardware and software, affecting all facets of basic research and advanced instrumentation.

Goals and Milestones (continued)

Configuration Optimization

- Achieve long-duration, high-pressure, well-confined plasmas in a spherical torus sufficient to begin design of a Next-Step Spherical Torus **(2008)**
- Demonstrate use of active plasma controls and self-generated plasma current to achieve high-pressure/well-confined steady-state operation for ITER **(2009)**
- Evaluate the ability of the compact stellarator configuration to confine a high temperature plasma **(2012)**
- Begin construction on the Next-Step Advanced Facility (NSAF) to test an advanced fusion concept for magnetically confining a fusion reaction **(2014)**

o Progress toward demonstrating enhanced fundamental understanding of magnetic confinement and improved basis for future burning plasma experiments through research on magnetic confinement configuration optimization **(2015)**

_ Advance plasma science and computer modeling to obtain a comprehensive, and fully validated, plasma configuration simulation capability **(2020)**

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o = Long Term Success Measure from PART
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NNSA = with NNSA
Interdependencies: Broadly with **ASCR** on computational developments, both hardware and software, affecting all facets of basic research and advanced instrumentation.

Goals and Milestones (continued)

<u>High Energy Density Physics</u>

- Evaluate the process affecting the transport of petawatt laser energy in dense plasmas **(2009) NNSA**
- Initiate experiments on the National Ignition Facility (NIF) to study ignition and burn propagation **(2012) NNSA**
- Create and measure properties of high energy density plasmas using intense ion beams, dense plasma beams, and lasers **(2012)**
- Begin construction of an intermediate-scale, Integrated Beam Experiment (IBX) to understand how to generate and transmit the focused, high energy ion beam needed to power an inertial fusion energy (IFE) reaction **(2014)**

o Progress toward developing the fundamental understanding and predictability of high energy density plasma physics **(2015) NNSA**

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