Oral Statement of
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Before the
Subcommittee on Energy and Environment
Committee on Science and Technology
U.S. House of Representatives
October 29, 2009

Thank you Mr. Chairman, Ranking Member Inglis, and Members of the Committee. I have been Director of this program since June 7th of this year and am thrilled to join this Office when the scientific readiness, opportunity, and urgency in fusion are extraordinarily resonant.

The pursuit of fusion energy embraces the challenge of bringing the power of a star to earth. Fusion's promise is enormous – nearly limitless fuel supplies, large-scale energy production, no greenhouse gas emissions. We are entering a new age in fusion science during which our knowledge base will be put to the test as researchers will undertake fundamental new studies of fusion energy's viability.

At the heart of fusion energy in the stars and on earth is the world's most famous equation, $E = mc^2$, which describes the fundamental relationship between mass and energy. The challenge is getting atomic nuclei of the fuel to bind together to form heavier elements, releasing enormous quantities of energy in the process. In the lab, we use hydrogen isotopes as the fuel. I've had the privilege of being part of experiments that have generated millions of watts of fusion power.

The science underpinning much of fusion energy research is plasma physics. Plasmas are hot gases, the stuff of stars and over 99% of the visible universe. Plasmas are routinely confined by magnetic fields and heated in laboratories to fusion conditions. The tokamak, a Russian invention from the 1960's, is studied worldwide and is the leading candidate "magnetic bottle" for creating fusion energy.

Dramatic progress prompted the National Academy of Sciences in 2004 to urge the U.S. to take a landmark step: it should participate in a fusion experiment in which the plasma "burns," or generates more energy than is used to heat it externally, and in large part heats itself. In response, the U.S. agreed to participate in the ITER project, to be built in Cadarache, France. We view ITER as a scientific instrument with the flexibility to reveal critical requirements for fusion's optimization. The seven members of ITER are China, the European Union, India, Japan, Russia, South Korea, and the U.S.. Construction will take place over the next decade, with burning plasma experiments slated to take place in the 2020's. The U.S. is committed to bringing a strong and effective approach to project management in ITER's design and construction.

Another approach to fusion is to compress the fuel extremely rapidly and rely on its inertia to confine it long enough for fusion to occur. This is being studied by the National Nuclear Security Administration for stockpile stewardship applications, and a joint program to study this extraordinary state of matter is being forged between NNSA and my office that will engage a broad array of laboratories and universities. Tests of this approach are being planned for the National Ignition Facility. If successful, they will be historic. The National Academy of Sciences has emphasized the importance of studying this plasma state to both energy research and to a rich array of scientific questions.

ITER's chances of success, and our prospects for deep scientific return, are intimately interleaved with a broad domestic research program in the fusion-related sciences. In the U.S, our multi-institutional program in experiment, theory, and computation is rich in discovery and impact. It is globally respected for its depth, accomplishment, and scientific aesthetic, and has had a major impact on the ITER design and research plan. Research is supported in 38 states at national labs, private industry, and about 60 universities. U.S. researchers participate in about 75 joint international activities. About 340 graduate students partake in fusion energy and general plasma science research.

Strategic planning is underway aimed at filling gaps in the world program so as to assert U.S. leadership where it best advances fusion as a whole while maximizing U.S. scientific return. For magnetic fusion, the scientific challenges can be broadly stated as follows.

> (1) Understanding and optimizing the burning plasma state. Experiments, theory, and simulation have significantly advanced our understanding of what to expect from a burning plasma, and will continue to do so. But ITER provides the only platform planned to directly test and expand our understanding of this complex physics.
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> (2) Understanding the requirements for extending the burning plasma state to long times – days, weeks, and longer. Many aspects of this are pursued in the U.S., and the second ten years of ITER's operation will put our understanding to crucial tests. However, overseas fusion programs are set to assert leadership in part through new billion dollar class research facilities in Europe, Japan, South Korea, and China. We are exploring growing our collaborations to increase their impact and the knowledge returned. And finally,
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> (3) Advancing the materials science for enduring the harsh fusion plasma environment, for extracting energy, and for generating fusion fuel *in situ*. We are beginning to outline our plans in these areas to develop a materials and fusion nuclear science program. Indeed, between fusion, fission, and defense-related research, we are beginning to assess the requirements for a cross-office "Materials for Energy" effort that would get the most out of common needs and resources.

Thank you, Mr. Chairman, for providing this opportunity to discuss the Fusion Energy Sciences Program. This concludes my testimony, and I would be pleased to answer any questions you may have.