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U.S. Department of Energy

Before the

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Subcommittee on Energy & Water Development

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Thank you Chairman Simpson, Ranking Member Kaptur, and distinguished members of the Committee. I am pleased to come before you today to discuss the President's FY 2015 Budget Request for the Office of Science in the Department of Energy. As you know, the DOE Office of Science is the Nation's largest source of funding for basic research in the physical sciences. Our research investments in basic science and user facilities are vital to advancing U.S. leadership in science and strengthening our national competiveness. I thank you and this Committee for your ongoing support for our mission. I also want to thank you for your support of the Office of Science in the recent FY 2014 Omnibus, which we are now implementing.

Coordination between the basic research and applied energy technology programs is a high priority for the Department, as demonstrated by the creation of the new Office of the Under Secretary for Science and Energy. Office of Science investments in critical materials and enabling infrastructure such as advanced computational facilities underpin applied R&D and technology development. Coordination between the basic and applied programs is maintained through activities such as joint planning meetings, technical community workshops, joint research solicitations, and focused "tech teams" in targeted research areas. Joint funding of research activities and facilities at the DOE laboratories and funding mechanisms that encourage broad partnerships are additional means to facilitate greater integration of the basic and applied research communities.

This year, in addition to a strong core of basic research, the Office of Science budget request highlights three themes: (1) research for advanced computing, computational sciences, and scientific modeling including the support of data collection and curation for model validation; (2) maintaining and improving the scientific user facilities as well as increasing availability to their users; and (3) construction of new scientific user facilities and urgently needed laboratory buildings and infrastructure.

Advanced Scientific Computing Research (ASCR) supports research to discover, develop, and deploy computational and networking capabilities to analyze, model, simulate, and predict complex phenomena important to DOE. The ASCR budget increases $62.9 million or 13.2% relative to the FY 2014 appropriation.

The request includes increases for research and development, for data-intensive science, and for prototypes in critical technologies such as processors and memory. These investments are necessary steps in the path toward capable exascale computers. Because big data and big computing go hand-in-hand, ASCR is also developing architecture to provide full lifecycle management of facility-generated data—observational, experimental, and simulation. In FY 2015, the request supports the development of a plan for system-wide architectures and for the expansion of demonstration projects to pilot studies to address selected data applications.

The National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory (LBNL) and the Leadership Computing Facilities at Argonne and Oak Ridge National Laboratories are funded to operate optimally. This year NERSC will move to its new home in the Computational Research and Theory Building at LBNL. The budget request also includes funding to support preparations for planned 75-200 petaflop upgrades for the Leadership Computing Facilities in the outyears.

This request also supports the initiation of a post-doctoral training program for high-end computing and computational science.

Basic Energy Sciences (BES) supports research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels in order to provide the foundations for new energy technologies. The BES budget increases $94.6 million or 5.5% from the FY 2014 appropriation. The request continues support for on-going core research, Energy Frontier Research Centers, and the Energy Innovation Hubs for Fuels from Sunlight and Batteries and Energy Storage.

The request includes a new activity for the development of computer modeling in materials science. This activity will provide the scientific foundation and tools for predictive design of functional materials. Though a leader in the development of many—if not most—scientific modeling codes, U.S. researchers still rely heavily on materials modeling codes developed outside the U.S. The new activity, which supports the Materials Genome Initiative for Global Competitiveness (MGI) that was initiated in June 2011 by the Administration, will significantly improve U.S. modeling capabilities. In order to gauge the

accuracy of the models, the activities will be combined with data from the BES facilities for synthesis, processing, and characterization of materials at the atomic and electronic levels

With the level of support requested for facility operations, four light sources, two neutron scattering sources, and five Nanoscale Science Research Centers all operate optimally. The National Synchrotron Light Source–II (NSLS-II) transitions to operations, and the National Synchrotron Light Source ceases operation. NSLS-II will enable scientists to probe the fundamental properties of matter with nanometer-scale resolution and atomic sensitivity, enabling discovery and innovation. With the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory operating at its design specifications and nearly fully instrumented, operations at the Lujan Center will cease. The Spallation Neutron Source is the world's brightest pulsed neutron facility and presently includes 16 instruments that are in high demand in disciplines from biology to condensed matter physics. The SNS will host an estimated 800 users in FY 2015.

Informed by the findings and recommendations of the July 25, 2013, Basic Energy Sciences Advisory Committee report *Future X-ray Light Sources*, the Linac Coherent Light Source-II (LCLS-II) project has been modified to include the addition of a superconducting linear accelerator and new undulators to support a high-repetition-rate free-electron laser. This new x-ray source will solidify the LCLS complex as the world leader in ultrafast x-ray science for decades to come. The Advanced Photon Source (APS) Upgrade MIE project will continue with planning, design, prototyping, and research and development related to implementation of a multi-bend achromat lattice that will achieve major improvements in source brightness and coherence. In addition, the NSLS-II Experimental Tools MIE project will continue with the design, procurements, construction/fabrication, installation, testing, and commissioning of equipment during FY 2015.

Biological and Environmental Research (BER) supports fundamental research and scientific user facilities to achieve a predictive understanding of complex biological, climatic, and environmental systems for a secure and sustainable energy future. The BER budget increases by $18.3 million or 3.0% relative to the FY 2014 appropriation.

The request continues support for research in Genomic Science, Climate and Environmental Science, the three DOE Bioenergy Research Centers, and the three national scientific user facilities—the Atmospheric Radiation Measurement Climate Research Facility (ARM), the Joint Genome Institute, and the Environmental Molecular Sciences Laboratory.

The request includes an increase to support activities that allow the expansion and incorporation of data from the ARM facility in an Earth system model with better than 10 kilometer resolution and improved certainty of prediction. Research includes the development of data assimilation methodologies and new atmospheric parameterizations of cloud, aerosol, and precipitation processes, relevant to scales as small as 10 meter resolution, to address cloud edge processes in high-resolution models. Work will exploit data from each ARM fixed facility and will be a component of each mobile facility deployment—providing unique and specialized testbeds for model improvement and validation based on recent ARM enhancements. The ARM fixed site in the Tropical Western Pacific will be closed in late 2014; instrumentation from this site will be incorporated into the fixed site at the Southern Great Plains to expand the footprint of this site in support of the work just described

Fusion Energy Sciences (FES) supports research to expand the fundamental understanding of matter at very high temperatures and densities and to build the scientific foundation of fusion energy. The FES budget decreases $88.7 million or 17.6% from the FY 2014 appropriation.

The National Spherical Torus Experiment (NSTX) will operate for an 18-week run following its 3-year-long upgrade. The new center stack assembly will enable a doubling of the magnetic field and plasma current and an increase in the plasma pulse length from 1 to 5 seconds, making NSTX the world's highest-performance spherical tokomak. Along with other upgrades, this will support a strong research program to develop the improved understanding of the spherical torus configuration required to establish the physics basis for next-step facilities, broaden scientific understanding of plasma confinement, and maintain U.S. world leadership in spherical torus research.

Following the restoration of Alcator C-Mod funding in the FY 2014 Omnibus, the request provides $18M of funding to support research and operations of a 5-week run for Alcator C-Mod. The DIII-D facility will operate for 15 weeks, a slightly reduced schedule owing to planned upgrades in FY 2015.

Funding is provided for the U.S. Contributions to ITER project to support the U.S. ITER Project Office operations, the U.S. cash contribution to the international ITER Organization, and continued progress on in-kind hardware contributions. These include industrial procurements of central solenoid magnet modules and structures, toroidal field magnet conductor fabrication and diagnostics, and tokomak cooling water system procurement.

In the spring of 2012, in efforts to ensure a responsible budgetary approach while maintaining contributions to the project, the administration agreed to support an annual funding level of no more than $225,000,000 per year beginning in FY 2014. Our present assessment of the international project is that

it cannot, under current conditions, meet the most recent schedule put forward by the ITER Organization. The requested level of funding for FY 2015 will ensure that U.S. in-kind contributions maintain U.S. commitment to FY 2015 project needs.

High Energy Physics (HEP) supports research to understand how the universe works at its most fundamental level by discovering the most elementary constituents of matter and energy, probing the interactions among them, and exploring the basic nature of space and time itself. The HEP budget decreases by $52.5 million or 6.6% below the FY 2014 appropriation.

The request supports the first full year of operations of the NOvA detector using the world's most intense neutrino beam generated at Fermi National Accelerator Laboratory; this experiment is a key part of the Intensity Frontier research program. NOvA will yield improved measurements of neutrino mixing and the first results that could provide insight into the neutrino mass hierarchy, as well as the search for CP violation in the neutrino sector. The planned CD-4 (Critical Decision 4, representing project completion) date is November 2014.

The request also supports the Muon to Electron Conversion Experiment (Mu2e) and the Muon g-2 MIE project. These experiments will probe energy scales beyond those achievable at Large Hadron Collider (LHC) through the study of rare processes and precision measurements. U.S. contributions to the Belle II project will be complete in FY 2015. The Belle II detector is located at the Japanese B-factory and will study rare decays and CP violation in the heavy quark systems. The planned CD-2 (baseline of the project) date is 4Q FY 2014. The Long Baseline Neutrino Experiment will continue design work consistent with recommendations of the community planning exercise to be completed in FY 2014. The FY 2015 request increases support for the Large Synoptic Survey Telescope during its second year of fabrication and focuses investments on strategic needs in accelerator stewardship. Research funding decreases in FY 2015 to offset these critical investments.

The High Energy Physics Advisory Committee has formed a Particle Physics Project Prioritization Panel, known as P5, to develop an updated strategic plan for the U.S. that can be executed over a 10 year timescale, in the context of a 20 year global vision for the field. The plan is to include an appropriate balance between small, mid-scale, and large experiments and core research. This important community-based exercise is due to be released in May of 2014, and will inform both the execution of the FY2015 budget as well as our FY2016 request.

Nuclear Physics (NP) supports research to discover, explore, and understand all forms of nuclear matter, including experimental and theoretical research to create, detect, and describe the varied forms of nuclear

matter that can exist, including those that are no longer found naturally. The NP budget increases $24.4 million or 4.3% relative to the FY 2014 appropriation.

The request continues to support construction of the Facility for Rare Isotope Beams at Michigan State University, which will provide intense beams of rare isotopes for research in nuclear structure and nuclear astrophysics.

The request supports the operation of the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory for 22 weeks, the same as in FY 2014. The RHIC facility is uniquely flexible, allowing study of colliding nuclei at variable energies spanning the transition to the new state of matter discovered at RHIC. The budget also supports 37 weeks of operation at the Argonne Tandem Linac Accelerator System (ATLAS) facility. ATLAS provides high-quality beams of all the stable elements up to uranium as well as selected beams of short-lived nuclei. Funding for the 12 GeV Continuous Electron Beam Accelerator Facility Upgrade at Thomas Jefferson laboratory decreases as accelerator commissioning is completed in FY 2015 and construction transitions to operations funding.

Science Laboratories Infrastructure (SLI) program supports new buildings and other urgently needed infrastructure improvements at our national laboratories. Funding is requested in FY 2015 to complete construction of the Science and User Support Building at the SLAC National Accelerator Facility. New projects in the FY 2015 request includeimportant infrastructure improvements at Princeton Plasma Physics Laboratory, which are fully funded; and complete design studies for the Materials Design Laboratory at Argonne National Laboratory; the Photon Sciences Laboratory Building at SLAC; and a new Integrative Genomics Building at LBNL.