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Office of the President

TO MEMBERS OF THE COMMITTEE ON OVERSIGHT OF THE DEPARTMENT OF ENERGY LABORATORIES:

DISCUSSION ITEM

For Meeting of July 18, 2013

UPDATE ON THE DEPARTMENT OF ENERGY LABORATORIES

Committee Chair Pattiz will report on the activities of the three University of California-affiliated Department of Energy (DOE) National Laboratories:

- Lawrence Berkeley National Laboratory (LBNL)
- Lawrence Livermore National Laboratory (LLNL)
- Los Alamos National Laboratory (LANL)

There will be a brief presentation on forest mortality in the Southwest as a result of climate change by LANL Principal Associate Director for Science, Technology and Engineering Alan Bishop, staff scientist Nate McDowell, and postdoctoral fellow Park Williams.

LANL Presentation to the Regents—Forest Mortality in the Southwest due to Climate Change

In the world's two largest drought experiments, both based in New Mexico, Nate McDowell, a staff scientist in the LANL Earth & Environmental Sciences Division, seeks to determine specifically why and where trees are dying. Mr. McDowell's Los Alamos team is working to create a global monitoring system to determine where trees are dying in order to improve predictions of future tree mortality. The team wants to determine how the rapid death of these trees—long-term carbon reservoirs—might create a significant new carbon source that could exacerbate the very climate change that's driving the accelerated pace of forest mortality in the first place. Mr. McDowell will discuss this LANL research program, which involves enveloping dozens of trees in Plexiglass chambers and connecting them to a myriad of sensing devices.

Park Williams, a young bioclimatologist and postdoctoral fellow at LANL, has teamed up with other specialists at the U.S. Geological Survey and the University of Arizona to devise a forest drought-stress index (FDSI) that can be used with other tools to project forest mortality for the southwestern United States and other areas. The FDSI was developed using a comprehensive tree-ring data set that integrates tree-ring measurements with climatological and historical records from 13,147 site-specific cross-sectioned specimens representing AD 1000-2007, gathered from more than 300 sites. The index shows a connection between drought and tree mortality associated with huge wildfires and bark-beetle outbreaks. Williams' study is also supported by satellite fire data from the past few decades, revealing an exponential relationship between drought stress and areas killed by wildfires. If the climate warms as expected, forests in

the Southwest will be suffering regularly from drought stress by 2050 at levels exceeding previous megadroughts. After 2050, Williams calculates, 80 percent of years will exceed those levels. Collectively, the results foreshadow 21st-century changes in forest structures and compositions, with transition of forests in the southwestern United States, and perhaps water-limited forests globally.

For additional information on these topics, refer to: http://www.lanl.gov/newsroom/news-releases/2012/October/10.01-climate-change-cripples-forest.php and http://e360.yale.edu/feature/megadrought_in_us_southwest_a_bad_omen_for_forests_globally/2665.

Benefits of the Enduring UC-National Laboratories Partnership

Partnership quick facts

The University has been involved in the management and operation of LBNL, LANL and LLNL since their inception, a relationship that spans seven decades. All three National Laboratories have a history and culture heavily influenced by the University and its principal missions of education, research and public service. The National Laboratories, in turn, contribute to the University's research and academic richness through joint research, educational collaborations, and the provision of unique experimental facilities available for UC research and graduate education. As indicated in the table below, the level of engagement between the University and the three National Laboratories is strong, and the UC fee revenue derived from the LLCs that manage LANL and LLNL provides approximately $17 million per year to support joint UC/National Laboratory research on some of the most challenging societal problems.

Federal Fiscal Year 2012

Fee Supported Joint UC/Labs Research Program* $17.1 million	LDRD Supported Joint UC/Labs Research $8.7 million	UC Users of Labs' R&D Facilities 449	UC-Educated Post Docs Working at Labs 191	UC/Labs Joint Peer-Reviewed Publications 665

* Fee derived from LANL and LLNL only. All other numbers include all three Laboratories (LBNL, LANL and LLNL).
LDRD: Laboratory-directed Research & Development (research funded by LANL, LBNL and LLNL research funds)

LLNL Director explores opportunities to enhance collaborations with UC Davis and UC Berkeley

LLNL Director Parney Albright, Deputy Director for Science and Technology Bill Goldstein, and University Relations Manager John Knezovich visited UC Davis on May 23, along with Dave McCallen of the UC Laboratory Management Office (LMO). The group met with UC Davis leadership, including Chancellor Katehi, Vice Chancellor Harris Lewin, and Dean of

Engineering Enrique Lavernia, as well as many faculty members. Discussions covered collaboration opportunities in Climate Change Prediction, High-performance Computing and Big Data, Geophysics and Seismology, Translational Biomedicine and Life Sciences, and Materials Science. Specific follow-up activities were identified to ensure that collaboration opportunities are fully realized.

On March 15, Director Albright, Chief of Staff Al Ramponi, and LMO's Mr. McCallen met with UC Berkeley Dean of Engineering Shankar Sastry, host Karl Van Bibber, Chairman of the Nuclear Engineering Department, and a number of other science and engineering department chairs to get an overview of current research activities and interests at UCB. LLNL has a long history of workforce recruitment, and education and research collaborations with the campus. Follow-up activities in High-performance Computing and Subsurface Science were identified as a priority.

LANL Director visits UC San Diego

LANL Director Charles McMillan, LANL Laboratory Fellow Chuck Farrar, and LMO's David McCallen visited UC San Diego on April 2-3 to receive a broad set of briefings on scientific and engineering research at UCSD and an update on the scientific and educational collaborations between LANL and the campus. The meetings included a demonstration of UCSD's unique outdoor shake table earthquake simulator, computational mechanics and materials science, and discussions of the unique architecture of the San Diego supercomputer. Mr. McMillan, Mr. Farrar, and Mr. McCallen also held a number of productive meetings with UCSD Chancellor Khosla and several department heads, and Mr. McMillan hosted a talk and poster session for students. LANL and UCSD have had a long and extremely productive relationship that spans from education and workforce development to cutting-edge collaborative research.

Regent Rubenstein visits LLNL

Regent Ronald Rubenstein visited LLNL on May 22. He toured the National Ignition Facility and the Forensic Science Center and received a full day of briefings on the breadth of the Laboratory's national security, energy and environmental, bio systems, high-performance computing programs, campus collaborations, and economic development activities.

President Yudof and Provost Dorr visit LANL

President Yudof and UC Provost Dorr spent a full day at Los Alamos on July 1, where they were briefed on LANL's weapons, global security, high-performance computing, science, technology and engineering programs, and UC/LANL collaborations and toured a number of the Laboratory's unique research facilities. LMO's David McCallen accompanied President Yudof and Ms. Dorr. The group also met with Laboratory Fellows and participated in a postdoctoral scholar poster session.

Ten researchers at the UC National Laboratories selected for DOE's Early Career Research Program

In May, DOE announced that 61 scientists and engineers from across the nation were selected to receive up to $15.3 million in funding for research grants as part of the Department's Early Career Research Program. The Early Career Research Program, now in its fourth year, supports the development of individual research programs of outstanding scientists and engineers early in their careers and stimulates research careers in the disciplines supported by the DOE.

The 61 researchers chosen for 2013 were selected by peer review from 770 university and national laboratory proposals. Of those selected, ten were from the UC-affiliated National Laboratories, four of whom received their doctorate degrees from UC campuses and two of whom have joint appointments at LBNL and UC Berkeley. The ten researchers are highlighted in Attachment 1.

Under the Early Career Research Program, university-based researchers will receive at least $150,000 per year to cover summer salary and research expenses. For researchers based at DOE National Laboratories, where DOE typically covers full salary and expenses of Laboratory employees, grants will be at least $500,000 per year to cover year-round salary plus research expenses. This funding is for the first year of planned five-year research grants, subject to congressional appropriations.

Lawrence Berkeley National Laboratory

Lawrence Berkeley Laboratory wins two of the DOE 2013 Project Management Awards

LBNL won two of DOE's top 2012 Project Management Awards: the Secretary's Award for Excellence and the Secretary's Award for Achievement. The Award for Excellence was given for the demolition of the Bevatron, the DOE's first-ever deactivation and demolition of a large-particle accelerator, which finished under budget, ahead of schedule, and with a sterling safety record. The Award for Achievement was received for the management of U.S. participation (along with Brookhaven National Laboratory) in the U.S./China Daya Bay Reactor Neutrino Experiment, including constructing the eight Antineutrino Detectors that produced extraordinary scientific results right from the start.

Lawrence Berkeley Laboratory research shows that boreal forests shift north and relinquish more carbon than expected as climate changes

New research by Lawrence Berkeley Laboratory's Charles Koven offers a way to envision a warmer future. It maps how earth's myriad climates—and the ecosystems that depend on them—will move from one area to another as global temperatures rise. The approach foresees big changes for boreal forests, which will likely shift north at a steady clip this century. Along the way, the vegetation will relinquish more trapped carbon than most current climate models predict. Boreal ecosystems encircle the planet's high latitudes, covering swaths of Canada, Europe, and Russia in coniferous trees and wetlands. This vegetation stores vast amounts of carbon, keeping it out of the atmosphere where it can contribute to climate change.

Complex computer simulations, called Earth system models, used to predict the interactions between climate change and ecosystems such as boreal forests, show that boreal habitat will expand pole-ward in the coming decades as regions to their north become warmer and wetter. This prediction would mean that boreal ecosystems are expected to store even more carbon than they do today. But LBNL research tells a different story. The planet's boreal forests will not *expand* pole-ward. Instead, they will *shift* pole-ward. The difference lies in the prediction that as boreal ecosystems follow the warming climate northward, their southern boundaries will be overtaken by even warmer and drier climates better suited for grassland. And that is a key difference. Grassland stores a lot of carbon in its soil, but it accumulates at a much slower rate than is lost from diminishing forests.

Koven's results come from a new way of tracking global warming's impact on Earth's mosaic of climates. The method is based on the premise that as temperatures rise, a location's climate will be replaced by a similar but slightly warmer climate from a nearby area. The displaced climate will in turn shift to another nearby location with a slightly cooler climate. It's as if climate change forces warmer climates to flow toward cooler areas, making everywhere warmer over time. This approach can help determine where a given climate is going to in the future, and where a given climate will come from. The research appeared online in the May 5 edition of the journal *Nature Geoscience*. See http://www.nature.com/ngeo/journal/vaop/ncurrent/abs/ngeo1801.html for additional information.

Lawrence Livermore National Laboratory

LLNL Lawrence Fellow wins 2013 Leadership Computing Challenge

A proposal submitted by Lawrence Fellow Frederico Fuiza has been chosen as a winner in the 2013 Leadership Computing Challenge program sponsored by the Advanced Scientific Computing Research in DOE's Office of Science. This recognition follows closely on the heels of the European Physical Society Award he won for his Ph.D. thesis. Much of the work that comprised this award-winning thesis was conducted at LLNL.

LLNL scientists identified promising new materials that may help capture methane

Methane is a powerful greenhouse gas and a substantial driver of global climate change, contributing up to 30 percent of the current net driver for climate warming. Concern over methane is mounting, due to leaks associated with rapidly expanding unconventional oil and gas extraction, and the potential for large-scale release of methane from the Arctic as ice cover continues to melt and methane from decayed organic material is released to the atmosphere. Methane is also emitted from a variety of other sources, including natural gas systems, livestock, landfills, coal mining, wastewater treatment, rice cultivation and a few combustion processes. At the same time, methane is a growing source of energy, making aggressive methane mitigation a key to avoiding dangerous levels of global warming.

LLNL researchers Amitesh Maiti, Roger Aines and Josh Stolaroff teamed with collaborators from UC Berkeley and LBNL to perform a systematic computer simulation study on the

effectiveness of methane capture. using two different materials—liquid solvents and zeolites (a class of highly porous materials commonly used as commercial adsorbents). Their simulations guided the discovery that liquid solvents hold little promise for methane capture, whereas a handful of zeolites had sufficient methane sorption to be technologically promising. The research appeared in the April 16 edition of the journal *Nature Communications* and showed how the search for materials effective in capturing methane is a challenge that can be addressed most effectively through extensive material screening and ingenious molecular-level designs. For additional information: http://www.nature.com/ncomms/journal/v4/n4/full/ncomms2697.html.

Los Alamos National Laboratory

Los Alamos supports disaster response for Moore, OK EF5 tornado

LANL's image-processing technology has intelligence applications, but is also used to assist disaster response during a national crisis—most recently the EF5 tornado that struck Moore, Oklahoma. Video footage acquired from KFOR TV's helicopter immediately after the May 2013 tornado provided an opportunity to apply LANL technology to assist with disaster response. Frame grabs of aerial footage, shot from an oblique angle, were rectified and matched with known overhead imagery. The process created image-based maps of the current status of the situation on the ground, providing information such as the extent of damage to houses and other infrastructure, as well as vehicle accessibility routes. The images gave agencies a clear, precise, location-specific picture of the situation on the ground without having to deploy ground crews. These geospatial products were shared with National Geospatial Intelligence Agency and Federal Emergency Management Agency.

LANL celebrates 70th anniversary

Throughout 2013, Los Alamos is celebrating its 70th anniversary of service to the nation. Committee Chair Pattiz and Provost Dorr will present Los Alamos Director Charles McMillan with a plaque honoring the Laboratory's 70 years of service. Free public lectures, spanning the early history of the Laboratory to the future of innovation at LANL, are some of the activities planned to mark the anniversary. Past lectures can be viewed on You Tube at: http://www.lanl.gov/museum/events/70th-events.shtml#past%20lectures.

Additional Resources

LBNL: http://www.lbl.gov
LLNL: https://www.llnl.gov/
LANL: http://www.lanl.gov/index.php
UC Lab Management web page: http://www.ucop.edu/laboratory-management/index.html

Attachment 1

UC-Affiliated National Laboratory Recipients for the 2013 DOE Early Career Research Program

LBNL – Seven Awardees (two with joint appointments at UC Berkeley)

- Aydin Buluc, who received a doctorate in Computer Science in 2010 from UC Santa Barbara, was selected for his proposal "Energy-Efficient Parallel Graph and Data Mining Algorithms." Buluc will explore methods to increase the energy efficiency of parallel algorithms and data-mining tasks. He will develop a new family of algorithms to drastically reduce the energy footprint and running time of graph and sparse matrix computations that form the basis of various data-mining techniques.
- Felix Fischer, who received a doctorate in Chemistry in 2008 from the Swiss Federal Institute of Technology, Zurich, was selected for this proposal "Atomically Defined Edge-Doping of Graphene Nanribbons for Mesoscale Electronics." Mr. Fischer's proposed research focuses on developing synthetic methods to create and fine-tune grapheme nanoribbons with atomic precision. Mr. Fischer has a joint appointment at LBNL and UC Berkeley, and this work will be conducted through UC Berkeley.
- Daniel Haxton, who received a doctorate in Physical Chemistry in 2006 from UC Berkeley, was selected for his proposal "The Multiconfiguration Time-dependent Hartree Fock Method for Interactions of Molecules with Strong Ultrafast High-Energy Laser Pulses." He plans to investigate a method to calculate what happens to a molecule exposed to intense, short laser pulses.
- Alexander Hexemer, who received a doctorate in Materials in 2006 from UC Santa Barbara, was selected for his proposal "High Performance Toolkit for Photon Science." The "toolkit" is designed to accelerate the rate of scientific discovery by enhancing the rate at which the enormous amount of data, generated at light sources like LBNL's Advanced Light Source, can be analyzed.
- Dominique Loque, who received a doctorate in Plant Molecular Biology in 2005 from the Universität Hohenheim, was selected for his proposal "Developing Synthetic Biology Tools to Engineer Plant Root Systems and Improve Biomass Yield and Carbon Sequestration." Mr. Loque, who works at the Joint BioEnergy Institute, has been using the tools of synthetic biology to reduce the recalcitrance and boost the polysaccharide content of plant cells walls without impacting plant development. This is part of the major DOE effort to speed the commercialization of advanced biofuels.
- Gabriel Orebi Gann, who received a doctorate in Particle and Nuclear Physics in 2008 from the University of Oxford, was selected for her proposal "Neutrino Physics with SNO+." An experimental particle physicist with an interest in weakly interacting particles, Orebi Gann's research focuses on neutrinos and dark matter. Ms. Gann has a joint appointment at LBNL and UC Berkeley. This work will be conducted through UC Berkeley.
- George Pau, who received a doctorate in Mechanical Engineering in 2007 from MIT, was selected for his proposal "A Multiscale Reduced-Order Method for Integrated Earth System Modeling." Mr. Pau is working on high-performance computing, model reduction and optimization algorithms relevant to earth sciences.

LLNL – One Awardee

- Yuan Ping, who received a Ph.D. in plasma physics at Princeton University, was selected for her proposal "Energy Transport in High-Energy Density Matter." Ms. Yuan's project aims to provide high-quality data on critical energy transport properties of high-energy-density (HED) matter. The data will also impact many other fields where HED science plays a crucial role, such as studies of geophysical phenomena, planetary formation, and astrophysical objects. Ms. Yuan is the tenth Livermore recipient since the award program's inception in 2010, which places LLNL tied for third most among the 17 DOE national laboratories and first among the three NNSA labs.

LANL – Two Awardees

- Marian Jandel, who received a doctorate in nuclear physics in 2003 from Comenius University, Bratislava, Slovakia, was selected for his proposal "New Data on Neutron Reactions Relevant to Basic and Applied Science." Mr. Jandel's research focuses on precise measurements of neutron fission and radiative capture using facilities at the Los Alamos Neutron Science Center. His work has also been recognized through a LANL distinguished-performance award as a member of the National Technical Nuclear Forensics Simulation Team and for his development of a new technology (patent pending) for large-area neutron detectors.
- Nathan Urban received a doctorate in computational condensed matter physics in 2006 from Pennsylvania State University and was selected for his proposal "Beyond the Black Box: Combining System and Model Dynamics to Learn about Climate Uncertainties." Postdoctoral appointments in geosciences at Penn State and public and international affairs at Princeton University resulted in Mr. Urban's changing his research focus to climate prediction and uncertainty quantification. As LANL's first Energy Security Fellow, Ms. Urban bridges physical science, computational modeling, statistics, decision-making, and policy, and coordinates LANL initiatives related to energy-climate impacts. His current research focuses on quantifying uncertainty in climate feedbacks, ice sheet dynamics, sea-level rise, and forecasting ocean climate variability, as well as decision-making under uncertainty and learning.

In addition to the above ten researchers associated with the UC-affiliated National Laboratories, Michelle O'Malley, Assistant Professor, Chemical Engineering, UC Santa Barbara, was selected by DOE for her proposal "Engineering Anaerobic Gut Fungi for Lignocellulose Breakdown."