Appendix A
Partnerships

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University Partnerships and Collaborations

Partnerships between the U.S. Department of Energy's (DOE's) national laboratories and universities strengthen our nation's intellectual and economic competitiveness. We are engaged in collaborative research and education initiatives with scientists at a wide variety of colleges and universities, both in the United States, and worldwide. Collaborative interactions with scientists and students at universities generate enthusiasm and new ideas through the sharing of insights, resources, and information. These interactions range from individuals from each institution participating in joint research sometimes supported by more formal arrangements such as Joint Research Institutes to support for teaching programs at regional colleges and universities. These collaborations in a diverse array of scientific and engineering disciplines serve to strengthen our capabilities, promote scientific discovery, provide educational opportunities, and bring together the best talent to work on DOE's most challenging issues. The following are examples of important research collaborations with universities that support our Laboratory agenda, DOE missions, and other government agencies.

Bio-Based Processing

We take part in Collaborative Institute for Bioproducts Research with Washington State University, University of Idaho, and the Idaho National Engineering and Environmental Laboratory (INEEL), and other universities.

Carbon Management and Climate Studies

We are a primary participant in the nation's two largest research and development consortia focusing on terrestrial carbon sequestration: 1) Consortium for agriculture; Soils Mitigation of Greenhouse Gas with multiple midwest and western universities, and 2) Carbon Sequestration in Terrestrial Ecosystems Research and Development Consortium with Oak Ridge National Laboratory and multiple universities across the United States.

To characterize the geology of the Ohio River Valley, we collaborate with Battelle Columbus, British Petroleum (BP), American Electric Power, Ohio State University, and West Virginia University.

With the University of Alaska at Fairbanks and BP, we collaborate on use of carbon dioxide to produce methane from methane-bearing formations in aluminum.

As part of the Joint Global Climate Change Institute with the University of Maryland (U of M), we conduct multidisciplinary research in three primary areas related to scientific and policy study of global energy and the environment: 1) leading the development of integrated assessment approaches to climate change, 2) establishment of energy-efficiency centers and creation of nontraditional funding mechanisms for energy projects, and 3) understanding both the effect of climate changes and the associated social vulnerabilities these effects may create. Through the U of M relationships with the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration, joint research efforts are strengthened.

More than 20 other universities partner with us in the Atmospheric Radiation Measurement Program to address some of the great uncertainties about greenhouse gases and the potential impact on global climate.

Computer and Network Infrastructure Security

We collaborate with the University of Idaho on computer hardware, network infrastructure security improvements, software to detect and deter intruders and preserve information integrity, and quality and security improvements of electronically mediated interactions.

Computational Sciences

Our Environmental Molecular Sciences Laboratory staff are active in collaborations in theory, modeling, and simulation with scientists from about 80 universities in the United States, and about 60 universities representing 60 countries.

Environment and Health

We are involved with the Superfund Basic Research Center with Oregon State University and Oregon Health & Science University to explore the effects of the nervous systems of environmental pollutants that contaminate water supplies.

We take part in Evergreen College's Student-Oriented Software program to explore distributed computing technologies to improve modeling systems in the Laboratory's Distributed Hydrology Soils Vegetation model.

We are involved in water resources research collaborations with regional universities to improve tools and understanding for better management of Pacific Northwest water resource management.

Imaging Science and Technology

We develop new methods for enabling humans to visualize and interact with three-dimensional datasets, in collaboration with the University of Washington.

We develop flexible architecture for integrating multiple image analysis stools with Pennsylvania State University.

Utah State University and Central Washington University each have image analysis collaborations with us that are planned and under way.

International Security and Nonproliferation

We are part of the Institutes for Global and Regional Security Studies with the University of Washington's Jackson School of International Studies and Department of Political Science and our Pacific Northwest Center for Global Security.

In addition, Princeton University, the University of California at Los Angeles, the University of Idaho, and Washington State University each have collaborations with PNNL that are important to technologies for nuclear arms control, nonproliferation, and verification activities vital to national security.

Life Sciences

Our Cell Systems Institute partnership agreement with University of Washington's School of Medicine focuses on joint research coupling theoretical and experimental studies of cell-signaling components of the dynamic information control systems in cells.

The Massachusetts Institute of Technology, the University of California at San Diego, and the University of Utah each have other systems biology collaborative research with us under way.

The University of Arizona, Harvard University, the University of Texas at Austin, the University of Washington, and the Fred Hutchinson Cancer Research Center have continuing biology-related collaborative efforts with us.

Nanoscience and Nanotechnology

Our Joint Institute for Nanoscience with the University of Washington focuses on particles films and nanoclusters for a variety of applications. This partnership is also supported by the National Science Foundation to support creation of new course work and incorporating distance learning tools in various nanoscience and nanotechnology areas.

Our Microproducts Breakthrough Center is a collaborative effort with Oregon State University to develop and help to market advances in microtechnology in our region.

Nuclear Energy

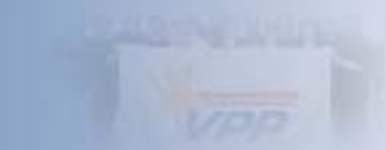
The University of Texas's Nuclear Engineering School is our partner in the DOE Nuclear Energy Research Initiative proposal to study and develop shielding materials for advanced light water reactor pressure vessels. With the University of California at Berkeley, we partner to develop an advanced nuclear fuel. With the University of Michigan, we conduct joint research materials for current and advanced nuclear reactors. The University of Illinois partners with us to evaluate basic mechanisms of interfacial deformation of materials. We collaborate with regional universities to promote the entry of students into the professions related to nuclear energy science and research.

Remote Sensing Applications

The Northwest Energy Technology Collaborative partners us with INEEL, the University of Washington, Idaho State University, Oregon State University, and the University of Idaho to improve the delivery of remote sensing and related spatial information technologies and applications from developer to end users.

Waste Characterization and Management

With several universities, we collaborate to solve waste disposal problems at the Hanford Site. Partnerships are active with Washington State University and Yale University to develop strategies for treating tank wastes. Washington State University analyzes material composition of tank wastes using laser ablation and mass spectrometry. With the University of Idaho, we partner on water sequestration and sonic methods for detecting plugs in waste transfer pipelines. Oxidation pathways in organic ion exchange media is our collaboration with Texas Tech University, and the University of California at Santa Barbara is our partner in materials separation research.



Our Natural and Accelerated Bioremediation Research Program with Washington State University and Montana State University is a collaboration in stopping movement of toxic metals in groundwater and soils at DOE facilities. We parnter with New Mexico State University, Florida State University, Oregon Health & Science University, Oregon State University, and theUniversity of Michigan to research other waste management areas. Our research under a DOE Environmental Management Science Program, with Oregon State University examines interactions between microbiological and hydrological processes in the unsaturated zone.

Instrumentation and Students

We partner with Heritage College to provide guidance and other support regarding the development of a horticultural initiative in the cultivation and propagation of native plants. We also provide adjunct faculty support to the teaching programs in environmental science and computer science. Students and faculty from Heritage College benefit from internships and research appointments at the Laboratory.

Oregon Universities System

A Memorandum of Understanding among the multiple universities in the Oregon University System with the Laboratory forms a cooperative relationship for research and educational activities, collaborations in the life, physical sciences, and economic development.

Northwest Virtual Entrepreneurial Support Network

Partners at PNNL and the Oregon Technology Transfer Council comprise the technology transfer officers from Oregon's research universities.

Washington State Universities, Tri-Cities

A collaborative program in systems biology is the newest of the regular and graduate courses at the local branch campus. PNNL staff members also teach short courses at the Washington State University Professional and Continuing Education Program.

The Consolidated Information Center (CIC) is our Hanford Technical library collection with the Washington State University library. The DOE Public Reading Room is also located at the CIC and operated by PNNL. The CIC also provides space for a Life Sciences Laboratory, museum, and conference rooms that are available to DOE and its contractors.

Industrial Partnerships and Collaborations

PNNL partnerships create opportunities for cost-effective research and ways to license promising new technologies. Among our major industrial partners are General Electric Company, Motorola, Delphi Engineering Group, Weyerhauser Corporation, Ford Motor Company, General Motors, PACCAR, Freightliner, E.I. DuPont de Nemours, Caterpillar, Boston Scientific Corporation, Sharp Microelectronics, Sawtec, Inc., IBM, Berkeley Instruments, Tektronix, and Coherent, Inc. (formerly Molectron Detector, Inc.).

The DOE Office of Science's Laboratory Technology Research Program supports a number of partnership projects with private industry to bring together the best talent and address DOE's most challenging issues. These cost-shared projects help to translate basic research advances to commercial applications over a broad spectrum of scientific disciplines such as advanced materials science, intelligent chemical processing, efficient manufacturing, sustainable environmental technology, and innovative biotechnology. We also work with and support local and regional businesses through technical assistance programs that help to diversify the local economy and create new jobs. Types of support to small businesses include resolving technical problems, testing and evaluating products and materials, and improving manufacturing processes.

Our industrial partnerships may also involve a broad variety of public and private institutions. In our **science** mission, we participate with DOE, other national laboratories and federal agencies, private companies, universities, and foreign research institutes in the Atmospheric Radiation Measurement Program to improve general circulation models used in climate research and to resolve scientific questions about greenhouse gases and their impact on global climate.

We participate in the Natural and Accelerated Bioremediation Research Program, a DOE Office of Biological and Environmental Research fundamental science research program on subsurface biological systems and their application to bioremediation, whose participants include DOE multiprogram national laboratories, several universities, and industrial participants.

In our **environmental quality** mission, we participate actively in the Environmental Management Science Program focusing Laboratory projects under this program on managing tank wastes and in situ treatment of groundwater. We partner with several industrial organizations on projects where the work directly supports critical DOE science needs for cleanup. We teamed with the Project Hanford management contractor, Fluor Hanford, to manage technology development for Hanford Site cleanup activities and to provide innovative solutions to expedite cleanup activities at the Plutonium Finishing Plant.

In our **national security** mission, we bring together the resources and highly specialized expertise needed to address the multidisciplinary nature of many national security issues, such as counterterrorism, weapons nonproliferation, and information security. We participate in the International Nuclear Safety Program, with the objective of reducing the risks of operating Soviet-designed nuclear reactors by working cooperatively with host countries of the former Soviet Union on nuclear safety and supporting technical infrastructure.

The Foundation for Russian American Economic Cooperation is a strategic Laboratory partner, which dates to the origins of the Nuclear Cities Initiative. We served as a key partner in establishing the International Development Centers in two of Russia's closed nuclear cities. Since this initial collaboration, the Foundation has continued to serve in this capacity under direct contract to DOE.

As part of the National Bureau of Asian Research, we have entered into a strategic alliance under the auspices of the Laboratory's Pacific Northwest Center for Global Security. We will provide science and technology knowledge and expertise in support of a new initiative titled *Tracking the Strategic Environment in Asia*. The program will track significant developments from Central Asia and Russia through south, northeast, and southeast Asia and across the Pacific to the United States. Under our sponsorship, the National Bureau of Asian Research received a grant from DOE's National Nuclear Security Administration to provide strategic analysis of the Asian security environment.

Partnerships in our **energy resources** mission address the difficult technical issues facing energy providers and consumers and provide industrial involvement from basic research through development, to ensure direct deployment of the results in industry.

We participate in the Solid-State Energy Conversion Alliance, which brings together Laboratory and industrial capabilities in material sciences, chemical processing, sensors, and modeling to develop and mass-produce clean, affordable, and high-efficiency modular solid-state fuel cell technology for diverse power needs in multiple market areas. We are working with the Washington Technology Center, Bonneville Power Administration, and other northwest organizations to implement the vision for a Northwest Regional Energy Collaborative. We have a partnership with Celerity and 6th Dimension for the EnergyWeb Project with Bonneville Power Administration. We will participate in the Massachusetts Institute of Technology's Consortium on Protocols for Dynamic Energy Control. We will assist Utility Automation Integrators, Inc., in the design and enhancements of the Dispatch 2.0 product, select a site for implementation of the outage management system demonstration in Alabama, and deploy an operational system at the site.

In the **building industry**, we work to advance and advocate the energy-efficient and environmentally sound design and construction of the nation's buildings. Our efforts include working with industry consensus standards organizations, such as the American Society of Heating, Refrigerating and Air Conditioning Engineers, and national model energy code organizations, such as the International Code Council, to develop progressive building energy codes and standards. We assist the states in the adoption/upgrade, implementation, and compliance processes by developing and distributing code compliance tools, materials, and services, and have provided approximately 40 states with individualized technical assistance. Our Emerging Technologies Program involves coordination with appliance and lighting manufacturers, and supports DOE's goal of advancing the development and sales of highly efficient new and emerging technologies.

In the **automobile industry**, we play a major role in the Northwest Alliance for Transportation Technologies, which addresses national technological challenges by focusing relevant industrial and research capabilities on specific transportation goals such as lightweight materials and emission controls. This partnership combines the strengths of national laboratories, research universities, and industrial manufacturers. The DOE Office of Transportation Technology supports this highly innovative, cost-sharing partnership with PACCAR (Bellevue, Washington, maker of Kenworth and Peterbilt trucks) and Freightliner (Portland, Oregon), the leading producers of heavy trucks in the United States. The partnership also supports active programs with the engine manufacturers to reduce diesel emissions in cost-shared partnership with Caterpillar, Ford, General Motors, DaimlerChrysler, and Cummins Diesel. These programs also support DOE's transportation focus in government industry partnerships in FreedomCAR and 21st Century Truck.

In the **electronics industry**, we focus on semiconductor materials science. We work with Oak Ridge National Laboratory and Motorola on development of new high-k dielectric films on silicon materials. We are working with eV Products, Inc., of Saxonburg, Pennsylvania, and Washington State University on a project to improve the availability of cadmium zinc telluride crystals.

In the **agricultural industry**, we partner with grower groups and processors in the corn industry, the National Corn Grower's Association, the Iowa Corn Promotion Board, and Archer Daniels Midland in a joint effort to create new nonfood markets for agricultural products as renewable alternatives to petroleum. A regional Collaborative Institute for Bioproducts Research is being formed by our Laboratory, INEEL, Washington State University, and the University of Idaho that will develop technologies for renewable biomaterials, such as potato waste and wheat bran, for chemical manufacturing.

In support of the **nuclear power industry**, we are working toward partnerships with leading developers of next-generation nuclear power plants where we can contribute expertise to diagnostic and prognostic instrumentation and controls, radiation materials sciences, fuel technologies, and waste processing. We participate in the Shelter Implementation Program Project Management Unit, which is a joint venture of Bechtel Corporation, Battelle, and Electricite de France to manage the European Bank for Reconstruction and Development program to stabilize the remains of the Chornobyl Unit 4 reactor. We plan to partner with nuclear engineering companies that are developing the next generation of modular nuclear reactors.