GUIDE to RESEARCH FACILITIES

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NATIONAL RENEWABLE ENERGY LABORATORY
FOR THE OFFICE OF
ENERGY EFFICIENCY AND RENEWABLE ENERGY
U.S. DEPARTMENT OF ENERGY

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The Guide in Brief

This *Guide* focuses on facilities that support programs funded by the Office of Energy Efficiency and Renewable Energy.

This *Guide* provides information on facilities at U.S. Department of Energy (DOE) and other government laboratories that focus on research and development of energy efficiency and renewable energy technologies. These laboratories have opened these facilities to outside users within the scientific community to encourage cooperation between the laboratories and the private sector.

The *Guide* features two types of facilities: *designated user facilities* and *other research facilities*.

Designated user facilities are one-of-a-kind DOE facilities that are staffed by personnel with unparalleled expertise and that contain sophisticated equipment. Other research facilities are facilities at DOE and other government laboratories that provide sophisticated equipment, testing areas, or processes that may not be available at private facilities. Each facility listing includes the name and phone number of someone you can call for more information.

You may use these facilities in many ways. You may use the expertise of the staff members, request experimental data, or send samples to a facility for testing. You may also conduct research in a facility, alone or with staff members. More formal uses include work-for-others agreements and cooperative research and development agreements. For more information on these agreements and other arrangements, contact

the technology transfer offices at the laboratory of interest.

The *Guide* contains four chapters and two indices. Chapter 1 is an overview of DOE's laboratory system, its technology transfer efforts, and the Office of Energy Efficiency and Renewable Energy. Chapter 2 describes each government laboratory and gives the name, address, and phone and fax numbers of someone you can contact for more information.

Chapter 3 lists 13 DOE designated user facilities that support work on energy efficiency and renewable energy. The facilities are listed alphabetically, first by DOE laboratory and then by facility name.

In Chapter 4, other research facilities are listed alphabetically, first by scientific or technical category, then by government laboratory within the category, and finally alphabetically by facility name.

The Facilities Index lists the individual facilities alphabetically first by government laboratory and then by individual facility. This will help you locate facilities by geographic area.

The Subject Index lists technologies, areas of research, and equipment. Because many facilities could easily fit under several broad technical categories, the subject index will help you find a facility if it is not where you first looked.

This is the first guide of this kind for the Office of Energy Efficiency and Renewable Energy. If you would like more copies, please call the Document Distribution Service at the National Renewable Energy Laboratory (NREL) at (303) 231-1243.

We intend to update the *Guide* periodically as new technologies and facilities come on line. If you have information you would like to see in the *Guide* or any suggestions on how to improve its usability, please contact Barbara Miller, NREL, at (303) 231-1970.

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Chapter 1

Inside DOE

The U.S. Department of Energy (DOE) is the government agency that oversees America's research and development (R&D) activities related to energy needs and uses. DOE's focus is on developing clean sources of energy to meet the needs of the economy while protecting the environment, transferring technologies from laboratories to the private sector, and cleaning up former weapons production facilities to protect public health and safety.

DOE's Office of Energy Efficiency and Renewable Energy is the lead organization for energy efficiency and renewable energy technology R&D. Its mission is to develop and promote the adoption of cost-effective renewable energy and energy efficiency technologies and practices. The office pursues its mission in partnership with the utility, industrial, buildings, and transportation sectors.

Utility-sector work involves developing ways of using existing energy sources more efficiently.

Work also centers on demonstrating the feasibility of alternative, renewable sources of electricity such as geothermal energy, hydroelectric power, wind energy, solar thermal energy, and photovoltaic energy.

Industry-sector work focuses on making industrial processes more efficient, minimizing industrial waste, and converting some wastes to useful energy or products.

Buildings-sector work includes developing building designs that take advantage of solar gains; building components, such as walls, roofs, and windows that minimize heat loss; and energy-efficient appliances.

Transportation-sector work includes research on alternative fuels, more efficient engines, electric vehicles, and mass transportation, such as the magnetic levitation train, to meet future needs.

Facilities at a Glance

This quick reference lists the number of research facilities at each government laboratory described

in this *Guide*. The left column lists the technology subject where you will find the descriptions.

Subject	Ames	ANL	BNL	FSEC	INEL	LBL	LLNL	LANL	NIST	NREL	ORNL	PNL	SNL
Analytical Equipment					1		1	3		6			
Basic Sciences	1									3		1	
Biochemistry and Biotechnology			1		1					4			
Building Technologies			1	4		7		1	6	2	2	1	
Electric Vehicles		1			1								2
Energy Storage and Distribution		2						1				2	
Engineering		2									2	3	1
Fuels and Chemicals				1						5		1	
Geothermal Energy					1			2					1
Materials	1	6	2		4			4	1	9	3	1	1
Modeling and Analysis			2				1	2					
Optics										2			1
Photovoltaics				2						8		1	4
Solar Resource Assessment				1						1			
Solar Thermal										1			
Superconductivity		1						4		1	3		1
Waste Management		3						1		2		1	
Wind Power										3			1
Designated User Facilities	1	2	1			2					5		2

Abbreviations

Ames—Ames Laboratory
 ANL—Argonne National Laboratory
 BNL—Brookhaven National Laboratory
 FSEC—Florida Solar Energy Center
 INEL—Idaho National Engineering Laboratory
 LBL—Lawrence Berkeley Laboratory
 LLNL—Lawrence Livermore National Laboratory

LANL—Los Alamos National Laboratory
 NIST—National Institute of Standards and Technology
 NREL—National Renewable Energy Laboratory
 ORNL—Oak Ridge National Laboratory
 PNL—Pacific Northwest Laboratory
 SNL—Sandia National Laboratories

Chapter 2

Government Laboratories

The government of the United States has for many years fostered scientific and technical education and research to improve America's competitive edge in the international marketplace. In today's highly competitive climate, it is becoming more important not only to continue developing new technologies but also to transfer these technologies to industry. As part of this technology transfer effort, the government is opening premier research institutions—the national laboratories—to universities, industry, and other research organizations.

Many of the 10 national laboratories were closed to researchers from the outside because of their

original defense mission. But the passage of the National Competitiveness Technology Transfer Act in late 1989 made technology transfer part of the mission of the national laboratories. This transfer ensures that new technologies can become useful products and processes that will be adopted by industry and consumers.

Most of the government laboratories listed in this chapter are DOE laboratories. The National Institute of Standards and Technology and the Florida Solar Energy Center are not but are listed because they receive part of their funding through DOE's Office of Energy Efficiency and Renewable Energy.

Ames Laboratory

Operated by Iowa State University

Contact

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Associate Director
Office for Planning and
Technology Application
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Iowa State University
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Ames Laboratory focuses diverse research strengths on energy-related issues of national concern. Through its programs, Ames seeks safe, environmentally sound solutions to complex problems encountered in the medium- to long-term regimes in energy production, storage, and use.

The laboratory's major program areas include materials sciences, chemical sciences, applied mathematics, fossil energy, high-energy physics, environmental sciences, and environmental restoration and waste management. Laboratory facilities are used to develop technologies such as corrosion-resistant and high-temperature materials and high-temperature superconductors. One facility, the Materials Preparation Center, is internationally recognized for preparing ultra-high-purity and well-characterized metals, alloys, compounds, and single crystals.

Extensive interaction with Iowa State University is maintained through faculty appointments, graduate student training, undergraduate and precollege science education, facility sharing, and innovative technology transfer programs.

The laboratory actively seeks opportunities for technical partnerships with U.S. industry, universities, and other governmental units through cooperative research and development agreements, work-for-others arrangements, and personnel exchanges.

To access a specific facility, contact the person listed at the end of the facility description. He or she can provide you with specific information about the technical and procedural steps for using that facility.

Argonne National Laboratory

Operated by The University of
Chicago

Contact

Paul Betten
Technology Transfer Office
Argonne National Laboratory
9700 South Cass Avenue
Building 900
Argonne, IL 60439
(708) 252-4962
FAX (708) 252-5230

Argonne National Laboratory conducts scientific research in basic physical sciences and applied research and engineering development in energy technologies. Research and development at Argonne link technology-based research with engineering development, from concept stages to application. Primary program areas at Argonne are nuclear energy, fossil energy, basic energy sciences, energy efficiency, renewable energy, biological and environmental research, and superconductivity.

Argonne supports research in energy efficiency through its work in such areas as heat transfer, waste management, and materials. Renewable energy research includes alternative transportation such as magnetic levitation trains.

Argonne has one of three high-temperature superconductivity research centers and one of three DOE pilot centers that collaborate with industry in advancing high-temperature superconductivity technologies.

To access a specific facility, contact the person listed at the end of the facility description. He or she can provide you with specific information about the technical and procedural steps for using that facility.

Brookhaven National Laboratory

Operated by Associated
Universities, Inc.

Contact

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Patent Counsel and Deputy
Manager
Office of Technology Transfer
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One role of Brookhaven National Laboratory is to conceive, design, build, and operate large, complex research facilities for fundamental scientific studies. A second role is to carry out both basic and applied research in energy-related physical, life, and environmental sciences. In providing the use of the laboratory's facilities to the scientific community, Brookhaven maintains close interaction with scientific personnel in universities and industry and aids in educating scientists and engineers through cooperative research programs. Other educational programs reach students and faculties from elementary schools through universities.

To fulfill its role as a multi-program laboratory, Brookhaven's scientific and technical activities include high-energy and nuclear physics; basic energy sciences emphasizing fundamental research on biological, chemical, and physical phenomena underlying energy-related transfer, conversion, and storage systems; and a broad span of applied programs for which the laboratory has unique capabilities. Brookhaven's research involves work with geothermal energy, energy systems analyses, and analyses of the environmental effects of siting photovoltaic arrays.

An integral part of Brookhaven's programs is the parallel effort to ensure that all useful results and knowledge obtained are made available to the industrial and commercial sectors. In that role, Brookhaven has several designated user facilities available to outside users. Although you can contact each of these facilities

directly, the Office of Technology Transfer can provide information on specific facilities and how to get in touch with the appropriate person.

You may perform either nonproprietary, usually basic, research or proprietary research at any of the designated user facilities. For more detailed information concerning research opportunities at any of Brookhaven's research facilities, contact the Patent Counsel and Deputy Manager (see first column).

Florida Solar Energy Center

Administered by the University of
Central Florida

Contact

Ingrid Melody
Florida Solar Energy Center
300 State Road 401
Cape Canaveral, FL 32920
(407) 783-0300 x139
FAX (407) 783-2571

The Florida Solar Energy Center functions as the energy research institute of the State University System of Florida. Created in 1974 as a nonprofit institute, the center is located at a research complex in Cape Canaveral. The center also operates two auxiliary research sites: one at Port Canaveral and one near the University of Central Florida area campus in Cocoa.

Under state and contract funding (some from DOE), the center conducts research and provides technical services in the areas of hydrogen energy from renewable resources, photovoltaic systems and applications, energy and building systems, advanced air-conditioning systems, and active solar thermal systems. Detailed analytical models are developed and validated with experimental data gathered from outside facilities. Systems analysis, cost-benefit analysis, and technology transfer follow research that demonstrates technology feasibility. Except when they are proprietary, results are published and widely disseminated.

To access a specific facility, contact the person listed at the end of the facility description. He or she can provide you with specific information about the technical and procedural steps for using that facility.

Idaho National Engineering Laboratory

Operated by EG&G Idaho, Inc.

Contact

Richard E. Hitt
Center for Business, Academic,
and Technical Transfer
Idaho National Engineering
Laboratory
EG&G Idaho, Inc.
P.O. Box 1625
Idaho Falls, ID 83415
(208) 526-9353
FAX (208) 526-0876

The Idaho National Engineering Laboratory is a multiprogram laboratory. Historically a leader in the DOE reactor technology programs and engineering projects, the laboratory conducts applied research and development to support the mission of DOE and other government agencies. The laboratory has expertise in

- biotechnology
- chemical sciences
- engineering science
- geothermal reservoir and exploratory technologies
- hydroelectric technologies
- materials and material processing
- environmental and waste treatment technology
- sensor development and measurement science
- information and communications technology.

The laboratory is working with universities and industry researchers to transfer new technologies to the private sector. In the past four years, the laboratory has transferred 31 such technologies to "spin-off" businesses, including an alarm filtering system, waste management and handling consultation, an oil/water separator, and a patented system for biodegrading mixed waste.

To access a specific facility, contact the person listed at the end of the facility description. He or she can provide you with specific information about the technical and procedural steps for using that facility.

Lawrence Berkeley Laboratory

Operated by the University of
California

Contact

Cheryl Fragiadakis
Technology Transfer Department
MS 90-1070
Lawrence Berkeley Laboratory
Berkeley, CA 94720
(510) 486-6467
FAX (510) 486-6457

Lawrence Berkeley Laboratory was founded in 1931 to advance physics and biomedical research through the development and application of the cyclotron, invented by Ernest Lawrence. Currently, the laboratory's major role is to perform leading multidisciplinary research in the energy, general, and life sciences. Energy-related activities include developing energy-efficient lighting and windows that insulate as well or better than well-insulated walls. Other activities include developing and operating unique national experimental facilities; educating and training the next generation of scientists and engineers; and transferring knowledge and technological innovations to industry, universities, and government.

The laboratory operates advanced electron microscopes and medium- and low-energy heavy-ion particle accelerators that are available for use by industry, academia, and others.

The laboratory maintains a strong relationship with the University of California and is located adjacent to the Berkeley campus. Industrial collaboration and technology transfer are strengthened through the Center for Advanced Materials, the Center for X-Ray Optics, and the California Institute for Energy Efficiency. The laboratory's Center for Science and Engineering Education advances undergraduate and precollege student and teacher involvement in its scientific activities.

To access a specific facility, contact the person listed at the end of

the facility description. He or she can provide you with specific information about the technical and procedural steps for using that facility.

Lawrence Livermore National Laboratory

Operated by the University of
California

Contact

Gilbert R. Marguth
Lawrence Livermore National
Laboratory
P.O. Box 808, L-795
Livermore, CA 94551
(510) 423-6416
FAX (510) 423-8988

Lawrence Livermore National Laboratory was established in 1952 to perform research on nuclear weapons and magnetic fusion energy. Since then, its mission has expanded to encompass research in other areas including applied energy technology and a broad range of ion-beam technology issues. These programs, in turn, are supported by research in basic scientific disciplines, computer science and technology, engineering, materials science, and physics.

The laboratory has particular strengths in fields such as scientific and engineering software, biotechnology, advanced materials, precision engineering, laser and electro-optic technology, microelectronics and instrumentation, and measurement technology.

To access a specific facility, contact the person listed at the end of the facility description. He or she can provide you with specific information about the technical and procedural steps for using that facility.

Los Alamos National Laboratory

Operated by the University of
California

Contact

Kay Adams
Director, Industrial Partnership
Center
Los Alamos National Laboratory
P.O. Box 1663, MS M899
Los Alamos, NM 87545
(505) 665-9090
FAX (505) 665-3125

Los Alamos National Laboratory is one of the largest multi-disciplinary, multiprogram laboratories in the world. Los Alamos' mission is to apply science and engineering capabilities to problems of national security. Recently, the mission expanded to include technology transfer to ensure that Los Alamos scientific expertise and technical solutions are available to industry. In support of this mission, Los Alamos conducts extensive research in such varied fields as energy, biomedical science, computational science, environmental protection and cleanup, and materials science. Energy-related activities include evaluating the potential of generating energy from hot dry rocks well below the earth's surface.

The Industrial Partnership Center at Los Alamos provides a point of contact for industrial collaboration; the center is industry's bridge to Los Alamos's varied resources. These resources, the scientific expertise of the personnel, and the equipment and facilities supporting these personnel are now available for use by industry.

Los Alamos has one of three DOE superconductivity pilot centers established to collaborate with industry in advancing high-temperature superconductivity technologies. In addition, Los Alamos has one of two DOE High-Performance Computing Research Centers. A Computational Testbed for Industry provides industry access to the supercomputing resources available at Los Alamos.

To access a specific facility, contact the person listed at the end of the facility description. He or she can provide you with specific information about the technical and procedural steps for using that facility.

National Institute of Standards and Technology

Operated by the U.S. Department
of Commerce

Contact

James E. Hill
Chief, Building Environment
Division
Building and Fire Research
Laboratory
National Institute of Standards
and Technology
Building 226, Room B306
Gaithersburg, MD 20899
(301) 975-5851
FAX (301) 990-4192

The National Institute of Standards and Technology, founded in 1901 as the National Bureau of Standards, was renamed by the Omnibus Trade and Competitiveness Act of 1988. The Act specifically directed the institute to assist industry in developing the technology needed to improve product quality, to modernize manufacturing processes, to ensure product reliability, and to facilitate rapid commercialization of products based on new scientific discoveries.

This explicit mission builds on a long-standing agency responsibility to both assist industry and develop, maintain, and retain custody of the national standards of measurement. As a nonregulatory agency of the U.S. Department of Commerce, the institute helps U.S. industry strengthen its competitiveness; advances science and engineering; and improves public health, safety, and the environment.

A world-class center for physical science and engineering research, the institute develops generic technology, measurement techniques, and standards. Researchers work at the frontiers of science and technology in such areas as electronics and electrical engineering, manufacturing engineering, chemical science and technology, physics, materials science and engineering, building and fire research, computer systems, and computing and applied mathematics.

With a staff of about 3000, the institute works with industries representing all major manufacturing sectors and many service

sectors, as well as state and local governments, more than 100 different federal agencies, standards organizations, the academic community, and the general public. Special efforts are made to tailor cooperative programs to the individual needs of research partners.

To use an institute facility, you must agree to conditions of use and rights to data and intellectual properties. You may conduct both proprietary and nonproprietary work at the institute. Use of a specific laboratory or test facility is subject to approval by the appropriate managers; scheduling depends on prior institute program commitments.

National Renewable Energy Laboratory

Operated by the Midwest
Research Institute

Contact

Dana Moran
Technology Transfer Office
National Renewable Energy
Laboratory
1617 Cole Boulevard
Golden, CO 80401
(303) 231-7115
FAX (303) 231-1997

As DOE's primary laboratory for renewable energy research, the National Renewable Energy Laboratory develops technologies that use the sun, wind, water, plants, and wastes to heat and cool buildings; run industries; light homes and offices; produce fuel for transportation; generate electricity; produce plastics, drugs, and chemicals; clean the water; destroy toxic wastes; and absorb carbon dioxide from the atmosphere.

The laboratory's research activities span several scientific, technical, and analytical areas. In materials sciences, investigations run from biobased materials and ceramics to superconductors and solid-state physics. Research in biosciences embraces biocatalysis, biochemistry, genetic engineering, and microbiology. Optics research includes lasers, optoelectronics, and solar concentrators. There are engineering programs in acoustics, structural dynamics, heat and mass transfer, thermal energy conversion, aerodynamics, and chemical processing. In photon interaction research, the laboratory investigates the role of sunlight in biological, catalytic, chemical, and photosynthetic processes.

The laboratory's resource assessment program appraises and measures the available renewable resources—sunlight, wind, water, and biomass. Analysis and measurement specialists characterize the crystallographic, electrical, optical surface, interface, and thermal properties of materials. Other specialists evaluate energy markets and analyze the economics of energy systems.

To use a facility, submit a proposal to the Technology Transfer Office. Before work is initiated, you must agree to conditions of use and the rights to data and intellectual properties. You may conduct both proprietary and nonproprietary work at the laboratory.

Use of a specific laboratory or test facility is subject to approval by the appropriate managers; scheduling depends on prior DOE program commitments.

Costs will vary, depending on the applicability and availability of the results to the laboratory's research programs.

Oak Ridge National Laboratory

Managed by Martin Marietta
Energy Systems, Inc.

Contact

L.B. Dunlap
Office of Guest and User
Interactions
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN 37831
(615) 576-2014
FAX (615) 576-4181

Oak Ridge National Laboratory is the largest of DOE's multiprogram national laboratories. Applied research and development activities concentrate primarily on energy and the environment, although considerable emphasis is also placed on the basic science that supports this work.

Oak Ridge conducts diverse energy programs. Conservation research and development is focused on more efficient ways to use energy, such as advanced heating and cooling systems and strong new ceramics for high-temperature engines. Renewable energy sources under study include fast-growing biomass, or energy crops, which can be converted to liquid or gaseous fuels. Fossil energy research explores ways to use coal cleanly and efficiently. Magnetic fusion seeks to harness the power of the stars to supply clean, unlimited power for the future.

Environmental work at Oak Ridge includes studies to better understand such phenomena as the greenhouse effect, ozone depletion, and strategies for managing hazardous and nuclear wastes. Basic research includes physics (nuclear, atomic, and solid-state), chemistry, materials science, computing and mathematics, and environmental sciences.

Oak Ridge is home to 10 designated user facilities and offers educational programs for thousands of students and teachers each year.

To access Oak Ridge facilities, submit a research proposal to the appropriate facility manager. You

must also effect an agreement with Martin Marietta Energy Systems.

Oak Ridge's acceptance of the proposal is based on the proposal's scientific merit, the suitability of the facilities for the proposed research, the selection of an Oak Ridge collaborator, and the appropriateness of the research to DOE objectives.

Concurrent with the approval procedure, the Office of Guest and User Interactions begins writing the user agreement. You can conduct both proprietary or nonproprietary research at Oak Ridge. Although there is no cost for nonproprietary research, you will have to pay all costs for proprietary research.

A single agreement allows you access to any Oak Ridge facility; however, you must submit a separate research proposal for each new project.

For additional information, contact the Office of Guest and User Interactions (see first column).

Pacific Northwest Laboratory

Operated by Battelle Memorial
Institute

Contact

Marv Clement
Technology Transfer Office
Pacific Northwest Laboratory
P.O. Box 999
Richland, WA 99352
(509) 375-2789
FAX (509) 375-6731

The missions of the Pacific Northwest Laboratory are the advancement of science and the rapid development and deployment of technology. As a DOE multi-program laboratory, the laboratory has the staff and the facilities to carry out research and development activities in the physical, biological, chemical, environmental, atmospheric, materials, and computational sciences. Engineering capabilities include developing technologies for waste management, environmental restoration, efficient energy use, nuclear energy use, and national security.

Current research and development activities focus on increasing energy efficiency in buildings and industrial processes; improving the scientific understanding of subsurface contaminant transport and global environmental processes; characterizing and remediating hazardous waste sites; gaining scientific understanding of phenomena at the molecular level; and linking research and development activities at universities, DOE laboratories, and industry to leverage federal investments and enhance technology transfer.

Integral parts of the laboratory's programmatic activities are to transfer technology to users in the public and private sectors, develop and operate scientific user facilities for researchers from these sectors, and contribute to the enhancement of science and mathematics education.

The laboratory also provides technical support for activities at the DOE Hanford National Environmental Research Park, including

independent environmental surveillance and oversight.

To access a specific facility, contact the person listed at the end of the facility description. He or she can provide you with specific information about the technical and procedural steps for using that facility.

Sandia National Laboratories

Operated by AT&T Technologies,
Inc.

Contact

Olen D. Thompson
Manager
Technology Transfer Applications
Dept. 4201
Sandia National Laboratories
P.O. Box 5800
Albuquerque, NM 87185
(505) 271-7822
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Technology Transfer Liaison
Division 8300A
Sandia National Laboratories
P.O. Box 969
Livermore, CA 94551
(510) 294-2678
FAX (510) 294-3422

Sandia National Laboratories enhance the security, prosperity, and well-being of the nation with research and development programs that contribute to military security, energy security, and economic competitiveness.

As one of DOE's largest research and development institutions, Sandia is currently readying itself for a future of faster technological and economic changes in a global community. For more than four decades, Sandia has undertaken technological and scientific challenges in many areas, including energy and the environment. It is now applying its capabilities to new, emerging responsibilities in areas such as advanced manufacturing, transportation, and technology transfer.

Sandia's approach is to concentrate on programs that strengthen core technical competencies; anticipate emerging trends to help its sponsors and customers invent their future; and team with industry, universities, and other institutions to pool resources.

Sandia's work in renewable energy and energy efficiency includes geothermal energy, solar thermal energy, wind energy, photovoltaics, and combustion.

Facilities include state-of-the-art equipment for research and testing in energy, environment, and radiation research; combustion research; computing; and microelectronics research and production. Other major facilities include a primary standards laboratory; transonic, supersonic, and hypersonic wind tunnels; and design,

fabrication, and process development laboratories.

To access Sandia's many facilities, contact the individual laboratory managers to obtain information on submitting research proposals or to discuss potential collaborative projects.

Chapter 3

Designated User Facilities

The term *designated user facility* describes the sophisticated scientific facilities, equipment, software and the expertise that are available at DOE laboratories for use by the U.S. technical and scientific community. This community comprises universities, private industry, other laboratories, and other government agencies. DOE established designated user facilities at its laboratories to encourage the scientific community to make use of this expertise to maintain America's technological edge in the world.

The characteristics of a designated user facility are these:

- They have broad uses in important scientific and technological research and do not compete with private capabilities.
- They have unique research capabilities that are generally very expensive, making their widespread duplication unlikely.
- Their primary purpose is to serve the research needs of the national laboratory scientific staff and to encourage industry and universities to get involved in government-funded research and development.
- They are managed so that sufficient time, space, and other resources are available to users without compromising the objectives of either the laboratory or DOE research programs.
- They provide adequate support services that allow an outside researcher to complete essential elements of an experiment.

- They provide for routine maintenance and repair.

DOE actively solicits recommendations from outside users for unique research capabilities. Outside users also participate fully in developing proposals for new facilities.

Designated user facilities are open to all members of the scientific and engineering communities. Users can do both proprietary and nonproprietary work. For information on costs, accessibility, and licensing of inventions, contact the facility of interest directly.

This chapter describes the 13 DOE designated user facilities* actively supporting energy efficiency and renewable energy research. The facilities are listed alphabetically, first by the name of the DOE laboratory and then by the name of the facility. Each facility lists a person to contact for user arrangements.

*The High-Flux Solar Furnace at the National Renewable Energy Laboratory was just designated a national user facility on July 16, 1993. See page 68 for a description.

Materials Preparation Center

Center Director

Frederick A. Schmidt
Materials Preparation Center
Ames Laboratory
Ames, IA 50011
(515) 294-5236
Hotline: (515) 294-8900

Description

The Materials Preparation Center serves the segment of the research community interested in specialized materials, including metals, intermetallic alloys, and ceramics. At the center, scientists can prepare, purify, fabricate, and characterize research quantities of these highly specific materials, such as rare-earth metals and compounds. The center also maintains and shares a data base containing up-to-date information related to specialized materials and services.

The center is divided into four sections: Advanced Materials Processing, Analytical, Materials Preparation, and Materials Referral System and Hotline.

The Advanced Materials Processing Section emphasizes powder processing and ceramic oxide crystal growth. Scientists use high-pressure gas atomization to produce ultrafine powders of metals and alloys. To grow single and polycrystalline ceramic oxide crystals, scientists use inductively coupled plasma.

The Analytical Group develops characterization techniques. Scientists analyze solutions using titrimetric and gravimetric techniques, spectrometric methods, flame atomic absorption, graphite furnace atomic absorption, and inductively coupled plasma atomic emission spectrometry. Instrumental techniques include chromatographic combustion, vacuum fusion, X-ray fluorescence, laser-ionization mass spectrometry, and single-event laser desorption time-of-flight mass spectrometry.

Activities in the Materials Preparation Section include preparing high-purity research-grade metals and alloys in single and polycrystalline forms. Typical efforts include preparing well-characterized research materials with highly specialized purity, grain size, homogeneity, and crystal quality and providing on-site training of representatives from client organizations.

Staff members in the Materials Referral System and Hotline Section collect, organize, and disseminate information about specialized materials. Staff members use the data base to locate sources of capabilities for preparing and characterizing materials and to respond to inquiries with a referral either to someone who has specific capabilities or to someone with advanced expertise in the area of interest. The hotline number is (515) 294-8900.

User Arrangements

Contact the center's director. Ames Laboratory exercises prudent confidentiality practices in all its transactions; formal nondisclosure agreements, with a high level of security, can be arranged.

Electron Microscopy Center for Materials Research

Facility Operations Manager

Edward A. Ryan
Materials Science Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-5222

Description

The Electron Microscopy Center for Materials Research uses high-voltage electron microscopes to examine the atomic structure of materials, primarily the material phenomena associated with ion and electron irradiation.

The center's primary microscope is the high-voltage electron microscope, which operates at 1.2 MV. The microscope is modified to permit specimens under examination to be bombarded with ion beams so researchers can observe the radiation-induced changes in the structure.

Three other microscopes at the center, which operate at 300, 120, and 100 kV, are also available. A second 300-kV microscope can perform on-line elemental spectroscopic analysis of materials.

The center also has two ion accelerators (0.3–2-MV-tandem and 30–650-kV-ion implanter) interfaced to the high-voltage electron microscope, which allows simultaneous ion and electron irradiation and transmission electron microscopy.

User Arrangements

To use the center, submit a brief proposal describing the study to be performed. The proposal will then be reviewed by the center's steering committee. Prospective users should request a copy of the *High-Voltage Electron Microscope—Tandem User Facility Guide*.

Intense Pulsed Neutron Source

User Administrator

Bruce Brown
User Administration Office
Argonne National Laboratory
Argonne, IL 60439
(312) 252-5518

Description

The Intense Pulsed Neutron Source produces neutrons, which penetrate matter and provide information about its atomic and molecular structure. The source serves researchers interested in performing basic, condensed-matter, materials, solid-state physics, and chemistry research. Users can examine the structure of such materials as high-temperature superconductors, alloys, composites, polymers, catalysts used in oil refining, and materials for advanced energy technologies.

The source produces neutrons by striking an enriched uranium target with a pulsed beam of protons accelerated in a synchrotron to 450 million eV. Because the synchrotron delivers the protons in bursts, the neutrons produced are delivered in high-intensity pulses. This greater beam intensity allows users to perform more experiments in less time and use many specialized instruments with greater precision and in new areas of research.

A subfacility, the Neutron Scattering Facility, has 13 slow neutron beam ports with diffractometers, spectrometers, and reflectometers. Diffractometers available are the special environment powder, general purpose powder, single crystal, and small-angle scattering. Spectrometers available are the low-resolution, medium-energy chopper; high-resolution, medium-energy chopper; quasi-inelastic; and a special one for low temperatures. For some scattering instruments, environmental chambers permit *in-situ* experiments to be

performed at high pressure (up to 35 kilibars), high temperatures (up to 1100°C [2012°F]), and low temperatures (down to near absolute zero).

User Arrangements

High priority is placed on making the facility and its instruments as easy and as convenient as possible for visiting scientists to use through ancillary equipment and computer facilities. The full-time staff is available to help users in carrying out experiments and in collecting and analyzing data.

Run times vary from a half a day to 10 days, with the average about 3–4 days. For additional information and the procedures for using the facility, contact the user administrator.

National Synchrotron Light Source

Laboratory Managers

James McBreen
Beam Lines X-11 and X-23A2
Department of Applied Science
Brookhaven National Laboratory
Upton, NY 11973
(516) 282-4513

James E. Wegrzyn
Beam Line X-12B
Department of Applied Science
Brookhaven National Laboratory
Upton, NY 11973
(516) 282-7917

Description

The National Synchrotron Light Source provides the world's brightest continuous source of X-rays and ultraviolet radiation for research. Two storage rings circulate bunches of electrons at 750 MeV in the vacuum ultraviolet portion of the electromagnetic spectrum and at 2.5 GeV in the X-ray portion of the spectrum.

The spectrum extends from infrared to gamma rays. Because electrons are accelerated in bunches, the resulting synchrotron-radiation also comes in pulses, each of which lasts about 300 trillionths of a second.

The National Synchrotron Light Source has three beam lines, the X-11, the X-12B, and the X-23A2, which are dedicated to research involving energy efficiency and renewable energy technologies. This technique is ideal for studying amorphous or disordered structures, including materials related to aqueous and lithium polymer electrolyte batteries, carbon-supported platinum and platinum-alloy electrocatalysts, and pyrolyzed metal macrocycle catalysts.

Beam line X-12B is a high-resolution, small-angle X-ray instrument-scattering light source capable of determining the pore structure of carbon adsorbents. These nanoscale structure measurements are crucial to developing porous absorbents for hydrogen storage and natural gas storage.

The 47 ports in the synchrotron's two storage rings can support as many as 100 simultaneous experiments.

User Arrangements

Beam time is allocated on the basis of competitive research proposals. In addition, general users have access, on a competitive basis, to beam lines built by this facility for the broad scientific community.

Advanced Light Source

Scientific Program Coordinator

Alfred S. Schlachter
Advanced Light Source
Lawrence Berkeley Laboratory
Berkeley, CA 94720
(510) 486-4892

Description

The Advanced Light Source, a next-generation synchrotron source of ultrabright X-ray and ultraviolet radiation begins research operations in August 1993. The source will benefit researchers in materials, interface, and surface science; and those in atomic and molecular physics, chemistry, the life sciences, and X-ray optics. It will also benefit researchers interested in developing the fabrication technology for micro- and nanostructures, as well as characterizing them.

The facility houses an accelerator complex and a complement of insertion devices, beamlines, and associated experimental apparatus.

The low-emittance storage ring has 10 straight sections available for insertion of undulators and wigglers. The source will initially feature 24 high-quality bend-magnet ports.

The undulators will generate high-brightness radiation at photon energies from below 10 eV to above 10 keV in the ultraviolet and soft X-ray regions of the spectrum. The wigglers will produce plane-polarized and elliptically polarized X-rays to 10 keV. Bend magnets will be useful below 10 keV; they will also provide infrared radiation.

In normal operation, radiation will comprise pulses having a full-width, half-maximum of about 30 ps and a separation of 2 ns.

Operation with pulse separations up to 656 ns can be arranged.

User Arrangements

Contact the scientific program coordinator for more information. The facility provides beam time to academic, industrial, and government researchers pursuing experimental programs broadly consistent with the DOE energy-research mission. Users also have the opportunity to collaborate with facility technical staff.

National Center for Electron Microscopy

User Administrator

Madeline Moore
National Center for Electron
Microscopy
Lawrence Berkeley Laboratory
Berkeley, CA 94720
(510) 486-5006

Description

The National Center for Electron Microscopy has high-voltage electron microscopes that can be used to examine the atomic structure of materials. The microscopes enable materials scientists to study samples under the most realistic conditions possible and to distinguish individual atoms even in closely packed metallic and ceramic structures.

Four microscopes are currently available. They include a 1-MeV atomic resolution microscope for ultrahigh-resolution imaging (approximately 0.15 nm), a 15-MeV high-voltage electron microscope (0.3 nm) designed for dynamic *in situ* studies, a 200-kV analytical electron microscope for energy-dispersive X-ray and electron-energy-loss spectroscopy, and a 200-kV high-resolution instrument (0.24 nm).

A comprehensive computing facility connects the microscopes to each other, allowing on-line image analysis, enhancement, simulation, and quantification of microanalytical spectra. Support facilities include specimen preparation laboratories, optical diffractometers, and photographic darkrooms.

The 400–1000-kV atomic resolution microscope has a point-to-point resolution of 0.16 nm. It can image, at the atomic level, densely packed structures typical of metals, ionic species in ceramics, and the interfacial structure controlling semiconductor properties. It also has a high-angle specimen-tilting stage that allows these atomic structures to be imaged in different projections.

The high-voltage electron microscope can image electrons of any energy between 150 kV and 1500 kV. At 1500 kV the beam can penetrate thick sections, providing images of internal structures representative of bulk materials. The instrument is equipped with stages for specimen heating, cooling, and straining experiments, and an environmental cell for studying gas-solid reactions at high temperatures.

User Arrangements

Submit research proposals to the user administrator. The proposals are reviewed and approved by the center's steering committee.

Bioprocessing Research Facility

Facility Manager

Brian H. Davison
Bioprocessing Research and
Development Center
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 576-8522
FAX (615) 574-6442

Description

The Bioprocessing Research Facility provides researchers with the equipment to pretreat and fractionate chemical feedstocks, select and improve microbial cultures, manipulate genes to produce designed proteins, design advanced bioreactors, develop advanced analytical concepts, determine the feasibility of using a bioprocess and scaling it up, monitor and control experimental bioprocesses, and conduct biochemical separations.

Equipment includes stirred-tank and columnar bioreactors from bench scale to a 500-L fermentation pilot plant for larger scale experiments. The columnar bioreactors range from 2.5 to 40.6 cm in diameter and vary in height from about 30 cm to about 10 m. They can be operated as fixed-bed or fluidized-bed bioreactors and are equipped to accommodate a variety of process monitoring and control equipment. A hammer mill, several continuous centrifuges, and a cold room are available for processing and separations.

Analytical equipment available to users includes gas chromatographs, spectrophotometers, gas analyzers, high-pressure liquid chromatographs, and an ion chromatograph.

User Arrangements

To discuss availability, contact the facility manager. Access is determined on the basis of scientific merit, technical feasibility, and compatibility of the proposed research with facility equipment

and operational priorities.

Approved users will receive guest appointments for the period of on-site work. Proprietary work may be carried out after contractual arrangements are made.

Buildings Technology Center

Facility Managers

Buildings Technology Center
Energy Division
Oak Ridge National Laboratory
Oak Ridge, TN 37831
FAX (615) 574-9338

Building Envelope Research
Center
Jeffrey E. Christian
(615) 574-4345

Heating and Cooling Center
Philip D. Fairchild
(615) 574-2020

Existing Building Center
William R. Mixon
(615) 576-7374

Description

The Buildings Technology Center is a multifunction facility where users can conduct thermal envelope research, develop, and test energy-efficient technologies for new and existing buildings. The center helps the buildings industry resolve technical issues and promote the development and application of these technologies.

Formerly called the Roof Research Center, the Center was recently expanded to include three recognized centers of excellence. The Building Envelope Research Center emphasizes capabilities in roof, wall, and foundation technologies; the Heating and Cooling Center emphasizes expertise in cooling, heating, and refrigeration; and the Existing Building Center specializes in auditing, retrofitting, and monitoring existing buildings.

Building Envelope Research Center. The centerpiece is the Large-Scale Climate Simulator where large roof sections, are sandwiched between two environmental chambers. The upper climate chamber simulates outdoor weather conditions; the lower metering chamber models interior conditions.

Researchers use the Rotatable Guarded Hot Box to test full-size wall, window, roof, and floor systems. The Roof Thermal Research Apparatus has four replaceable roof panels and a controlled interior. Two calibrated slab-foundation edges measure thermal performance of slab-on-grade insulation systems.

The Envelope Systems Research Apparatus resembles a residential basement topped with a typical commercial low-sloped roof. It is used to study energy and moisture flow through walls, foundations, and roofs.

Heating and Cooling Center. This area includes a large, two room (indoor/outdoor) environmental chamber used to simulate temperature and humidity conditions. Advanced air-conditioning, refrigeration, and heat pump systems and technology are developed in this facility. Two smaller chambers are used to research appliance and compressor efficiency.

Calorimeters and specialized test apparatus are used for evaluating chlorofluorocarbon and hydrochlorofluorocarbon replacement refrigerants, and heat-exchanger test apparatuses for refrigerant mixtures are used to investigate and validate thermal performance benefits of refrigerant-side- and air-side-enhanced heat exchanger surfaces.

Existing Building Center. Research focuses on improving energy efficiency of existing buildings. Users can develop tools for programs such as the National Weatherization Program and the National Energy Audit. Auditing, retrofitting, and monitoring tasks are accomplished using sensors and data acquisition systems to analyze building performance in the field. The center is also used to train energy auditors.

User Arrangements

Contact the manager for each area.

High Temperature Materials Laboratory

Laboratory Director

V.J. Tennery
High Temperature Materials
Laboratory
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-5124
FAX (615) 574-4913

Description

The High Temperature Materials Laboratory is used to help solve the materials problems that limit the efficiency and reliability of advanced energy-conversion systems. The facility serves as a focal point for multidisciplinary research on new ceramics and metallic alloys that have potential for high-temperature applications such as automobile engines.

Each of six "user centers" focuses on a specific area of research in materials science. The Materials Analysis Center uses electron microscopy and surface chemical analysis to determine surface chemistry and microstructure down to the atomic level. A new field-emission gun-transmission electron microscope provides the highest lateral resolution presently attainable for X-ray elemental analysis. Because the field emission source illuminates the specimen coherently, users can perform electron holography.

Researchers use the Mechanical Properties Center to focus on fracture toughness and tensile strength. The center is equipped with six high-temperature flexure load frames, room-temperature and high-temperature tensile testing load frames, fiber test and composites test machines, two universal test machines, and a mechanical-properties microprobe.

The electromechanical tester is an ATS model 1220 instrument with a load capacity of 89 kN. It can apply loads up to 20 kN at test speeds ranging from 0.8 $\mu\text{m/s}$ to 0.8 mm/s. Compression and flexure tests can be performed

in air, gas, or vacuum up to 1500°C.

The Physical Properties Center is used to study thermal stability, expansion, and conductivity. The X-Ray Diffraction Center is used for studies of materials properties at temperatures up to 2700°C in vacuum conversion and up to 1500°C in air conversion. An automated xenon-flash instrument allows diffusivity measurements to be made at room temperature. A laser-flash instrument does the same at high temperatures.

The Ceramic Specimen Preparation Center uses slicers and grinders, which are open-loop and numerically controlled, including one four-axis grinder. Other equipment includes an optical comparator, a computer-controlled profilometer, and strain gauges.

The Residual Stress Mapping Center uses an X-ray diffractometer to measure residual stress and texture in and near the surface of ceramics and alloys. A stress and texture goniometer is equipped with a Peltier-cooled solid-state detector and an 18-kW rotating anode generator. The system provides flexible sample tilt and either a divergent or a parallel beam.

User Arrangements

Contact the laboratory director. Access is determined on the basis of scientific merit, technical feasibility, and compatibility of the proposed research with facility equipment and operational priorities.

Shared Research Equipment Program

Laboratory Managers

Neal D. Evans
Science Engineering Education
Division
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 576-4427
FAX (615) 574-0641

Edward A. Kenik
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-5066
FAX (615) 574-0641

Description

The Shared Research Equipment Program gives researchers access to state-of-the-art research instruments and facilities. Capabilities include transmission electron microscopy, atom-probe field-ion microscopy, surface analysis, nuclear microanalysis, and mechanical-properties microanalysis.

Available equipment includes conventional and analytical transmission electron microscopes. Several analytical electron microscopes are capable of energy dispersive X-ray spectroscopy, parallel- or serial-detection electron-energy-loss spectroscopy, convergent beam electron diffraction, and scanning transmission imaging.

One 120-kV analytical electron microscope has a high-brightness field emission gun for use in experiments requiring small (<2 nm) probe diameters. A 300-kV microscope can provide lattice and structural imaging to about 0.2 nm.

Several other instruments provide atom-probe field-ion microscopy capabilities that are state of the art. These include field-ion and field-emission microscopes, high mass resolution Poschenrider-style and reflectron-type energy-compensated time-of-flight mass spectrometers, imaging atom probe detectors, a three-dimensional atom probe, and surface preparation chambers.

Surfaces can be analyzed using a scanning Auger microprobe having a spatial resolution of 200 nm.

Other microprobes permit electron spectroscopy for chemical analysis, low energy diffraction, and low resolution scanning (3–5 μm).

A mechanical properties microprobe can determine both elastic and plastic mechanical properties using programmed loading sequences from 0.05 to 300 mN. Indentations as small as a few nanometers can be routinely made.

Three ion accelerators (400 keV, 2.5 MeV, and 4.0 MeV) can irradiate a metal, ceramic, or polymeric target with one, or simultaneously with two or three ion species. Target temperature during irradiation can be set from near liquid nitrogen to 1000°C.

User Arrangements

Proposals must identify at least one Oak Ridge National Laboratory staff member and one outside participant who will share responsibility for the project. Submit proposals to the staff member named in the proposal. Proposals are evaluated on the basis of scientific excellence and relevance to DOE interests.

Exploratory studies to test the feasibility of new or unusual research ideas are expected to be short-term efforts. If they are successful, more extended projects can be proposed.

Surface Modification and Characterization Research Center

Scientific Liaison

P. Withrow
Surface Modification and
Characterization Research Center
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 576-6719
FAX (615) 576-6720

Description

The Surface Modification and Characterization Research Center is used to alter and characterize near-surface properties of materials using ion beams. Users can conduct fundamental materials research on crystal growth and structure, stability of materials, and radiation effects, for example. In addition, users can modify surfaces for practical applications in areas such as friction, wear, corrosion, catalysis, surface hardness, semiconductor devices, and superconductors.

The center is equipped with particle accelerators that can be used to alter the physical, electrical, or chemical properties of the near-surface region of solids, creating unique materials. Specific techniques include ion implantation doping, ion-induced mixing, and pulsed laser processing.

User Arrangements

Submit a research proposal describing the project to the center's scientific liaison. Proposals are reviewed for scientific merit, suitability for these facilities, and appropriateness of the research to DOE goals.

Combustion Research Facility

User Administrator

W.J. McLean
Combustion Research and
Technology Center
Sandia National Laboratories
P.O. Box 969
Livermore, CA 94551
(510) 294-2687

Description

Scientists use the Combustion Research Facility to improve their understanding and control of combustion processes. Typical projects range from fundamental studies of combustion-generated pollutants to applied studies of processes in internal combustion engines.

This facility comprises some 20 individual laboratories. Laser systems include one for remote pumping of dye lasers, a flash-lamp-pumped dye laser for imaging applications, and a neodymium: YAG-pumped tunable dye laser for coherent anti-Stokes Raman spectroscopy.

Other laboratories include facilities for chemical dynamics, pulse and spray combustion, imaging of turbulent reacting flows, internal combustion engine studies, supercritical water oxidation, and coal research.

User Arrangements

Submit research proposals to the facility director.

National Solar Thermal Test Facility

User Liaison

Christopher P. Cameron
National Solar Thermal Test
Facility
Solar Thermal Test Department
Sandia National Laboratories
P.O. Box 5800
Albuquerque, NM 87185
(505) 845-3140

Description

Located on the Kirtland Air Force Base in Albuquerque, the National Solar Thermal Test Facility is used for tests requiring intense heat and for collecting light with large-scale optics. Specific high-thermal flux applications include investigating the thermophysical properties of materials and testing various solar applications. Large-scale optics can be used for astronomical observations and atmospheric sounding with Lidar.

The facility has several test areas. One consists of 222 computer-controlled heliostats that reflect concentrated solar energy onto a 61-m (200-ft) high tower. This test area provides 5 MW of total thermal power, peak flux to 260 W/cm^2 , illumination of target areas up to 28 m^2 (300 ft^2), and time-dependent control of the thermal flux. Applications include simulation of aerodynamic heating; photocatalytic reactions, including destruction of hazardous wastes; materials processing; and process heat and electricity generation.

A second test area contains two 10.8-m (36-ft) diameter parabolic dishes that provide 75-kW total thermal power each, peak flux up to 1500 W/cm^2 , tailored power levels and flux distribution, and square-wave transients from shutters mounted at the focal point. Applications include testing heat engines connected to electrical generators at the focal point, measuring the thermophysical properties of materials, evaluating thermal and photocatalytic solar receivers, and collecting light for atmospheric sounding with Lidar.

A third test area features two solar furnaces. The furnaces use a heliostat to track the sun and direct the sunlight into a mirrored parabolic dish. One furnace provides 16-kW total thermal power and peak flux up to 500 W/cm^2 . Another furnace provides 65-kW total thermal power and peak flux up to 1000 W/cm^2 . Applications include investigating the thermophysical properties of materials and determining the performance and failure thresholds of high-temperature ceramic and refractory materials.

The test facility also has a series of line-focus parabolic troughs that track the sun in one axis to concentrate solar power in a line, usually a tubular receiver. Four line-focus systems offer a 1161-m^2 ($12,500\text{-ft}^2$) surface. A rotating platform and collector module present efficient two-axis tracking. These systems provide 800-kW total thermal power and peak flux up to 6 W/cm^2 . Typical applications include destroying dilute chemicals in water and generating industrial process heat.

The facility's engine test laboratory is used to test solar energy components indoors before they are tested in a field system.

The test facility also offers excellent support for experiments conducted on location.

User Arrangements

The facility is available to support any application that can benefit from its unique capabilities. For further information, contact the user liaison.

Chapter 4

Other Research Facilities

Other research facilities include major scientific instrumentation centers, laboratories, and other government facilities that, although primarily developed to serve laboratory staff, could be of interest and benefit to the entire technical community. These facilities are located at DOE and other government laboratories throughout the United States. A facility may be an outdoor area used for testing prototypes, materials, or processes, or it may be a room containing sophisticated equipment.

These other research facilities are open to all members of the scientific and engineering communities. Users can do both proprietary and nonproprietary work. For information on costs, accessibility, and licensing of inventions, contact the facility of interest directly.

The facilities listed here are organized alphabetically, first by the scientific or technical category listed in the header and then by the name of the government laboratory. Individual facilities are listed alphabetically within their laboratory. Each facility lists a person to contact for user arrangements.

Idaho National Engineering Laboratory

**Inorganic Membrane
Technology Research
Laboratory**

Description

This facility is used for synthesizing, casting, and characterizing inorganic polymers for membrane-based separation processes in harsh industrial environments.

A completely equipped chemical synthesis laboratory, including a 300-MHz nuclear magnetic resonance spectrometer, is used for polymer syntheses, characterization, and development, allowing users to custom design polymeric materials for specific applications. The membrane performance facility is equipped with fully pure and mixed gas testing equipment. Several pervaporation and other liquid-liquid and liquid-vapor systems of varying sizes are also available. The systems are equipped with gas chromatographs (both on-line and off-line) for data analysis.

User Arrangements

Contact the laboratory managers.

Laboratory Managers

Eric Peterson or
Mark Stone
Materials Chemistry
Idaho National Engineering
Laboratory
Idaho Falls, ID 83415
(208) 526-1521 or 8664

Lawrence Livermore National Laboratory

**Center for Accelerator Mass
Spectrometry**

Description

This center is used for various analyses such as global climate change and industrial applications, specifically materials characterization and biological specimen analysis.

The center houses a large tandem Van de Graaff accelerator. Major permanent research beam lines include an accelerator mass spectrometer optimized for the isotopes ^{10}Be , ^{14}C , ^{26}Al , ^{36}Cl , ^{41}Ca and ^{129}I ; beta and gamma spectrometers for nuclear structure research; a beam line for hydrogen depth profiling; and two ion-imaging beam lines for tomography and nuclear reaction analysis. One imaging beam line can work down to 100 μm ; the second to 0.25 μm . A developmental spectrometer for tritium accelerator mass spectrometry and an ion microprobe targeted for 10-nm spot size are also available.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Jay C. Davis
Lawrence Livermore National
Laboratory
Livermore, CA 94551
(510) 423-1414

Los Alamos National Laboratory

**Superconductivity
Technology Center: Electron
Microscope Facility**

Description

This facility is used to analyze samples prepared for superconductivity and materials.

Equipment includes two CM-30 Phillips transmission electron microscopes and a scanning electron microscope with many analytic attachments. One CM-30 is used for high resolution and the other for analytic work. These CM-30s are made available to users through the Center for Materials Science.

User Arrangements

Contact Dean Peterson at
(505) 665-3030. Collaborative work
is available free of charge.

Laboratory Manager

Terence E. Mitchell
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 667-0938

Los Alamos National Laboratory**Superconductivity
Technology Center: Ion-
Beam Materials Laboratory****Description**

This facility is used to analyze samples prepared for superconductivity and materials.

This facility is built up around a 3-MeV tandem van de Graaf accelerator and a 200-keV ion implanter. Downstream is equipment for Rutherford back-scattering, nuclear microprobe channeling, depth profiling, molecular beam epitaxy, and various optical probes.

User Arrangements

Contact Dean Peterson at (505) 665-3030. Collaborative work is available free of charge.

Laboratory Manager

Joseph R. Tesmer
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 667-6370

Los Alamos National Laboratory**Superconductivity
Technology Center: X-Ray
Characterization Laboratory****Description**

This facility is used to analyze samples prepared for superconductivity and materials.

Six different X-ray generators offer computer-controlled single-crystal and powder diffraction in various sample environments as well as X-ray fluorescence.

User Arrangements

Contact Dean Peterson at (505) 665-3030. Collaborative work is available free of charge.

Laboratory Manager

Eric J. Peterson
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 665-3385

National Renewable Energy Laboratory**Analytical Laboratories****Description**

These facilities are used to characterize molecular structures in solutions of catalysts or complexes and to examine the surface structure of semiconducting particles and electrodes for photoconversion processes.

Equipment includes a 300-MHz nuclear magnetic resonance spectroscope and an ambient scanning tunneling microscope.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Michael Seibert
Basic Sciences Division
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1879

National Renewable Energy Laboratory

FTIR Spectroscopic Research Center

Description

This facility houses several FTIR (Fourier transform infrared) spectrophotometers that can provide vibrational spectra of a wide range of solid, liquid, or gaseous samples.

Capabilities include FTIR microspectroscopy, *in situ* FTIR spectroscopy at temperatures from 8 K to 900 K, FT-Raman and FTIR-photoluminescence spectroscopy, and many types of reflectance FTIR spectroscopy. Typical analyses include quantitative analyses of dopants and impurities in photovoltaic materials, identification of reaction products on catalyst surfaces, and contamination or degradation analysis of photovoltaic and aerospace materials.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

John Webb
Measurements and
Characterization Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1203

National Renewable Energy Laboratory

Microbalance Laboratory

Description

These facilities are used for ultra-sensitive determinations of mass and weights. The equipment uses the change in crystal growth frequency to obtain mass changes of a material coated onto a quartz-crystal oscillator. This information is useful for any technology that depends on the stability of surfaces and interfaces in gaseous or vacuum environments (absorption, desorption, corrosion, oxidation, or reduction). One use is to obtain the equilibrium capacity of desiccant materials during adsorption and desorption of water vapor from the solid desiccant and to secure the rate of approach to equilibrium at each water-vapor pressure.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Alvin W. Czanderna
Measurements and
Characterization Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1240

National Renewable Energy Laboratory

Microscopy and Materials Characterization Laboratories

Description

These facilities are used to analyze photovoltaic and electronic materials for structural, chemical, compositional, crystallographic, defect, luminescent, and topographical properties. Equipment includes: high spatial-resolution transmission electron microscope (TEM), scanning electron microscopes (SEM), X-ray diffraction and fluorescence systems, and an electron probe microanalysis system. Techniques include lattice-resolution TEM, micro-cathodoluminescence, electron channeling, electron beam induced current and voltage, energy dispersive and wavelength dispersive spectroscopies. Laboratories include complete electron microscopy preparation facilities.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

M. Al-Jassim
Measurements and
Characterization Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1042

National Renewable Energy Laboratory**Molecular Beam Mass Spectrometer Laboratory****Description**

This facility is used to study biomass-derived feedstocks that can be converted to useful fuels and chemicals. Specific items being studied include complex biomass gasifier tars, analytical pyrolysis for fuel biomass and waste feedstocks analysis, thermal processing of plastics wastes for high-value chemicals recovery, and the release of alkali vapor in the high-temperature combustion of woods and grasses.

This facility comprises two direct-sampling, molecular-beam, mass-spectrometer systems—one fixed and the other transportable for field applications. These systems can extract and measure reactive and condensable species from hot, moist, particle-laden, reactive systems under simulated or real reactor or stack conditions. The mass spectrometer provides a nearly universal detector, and advanced multivariate analysis capabilities aid deconvolution and interpretation of complex spectra. The nature of the sampling and the fast response of the quadrupole mass spectrometer permits real-time monitoring in the millisecond-to-second range.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Tom Milne
Process Research Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1440

National Renewable Energy Laboratory**Nanoscale Science and Technology Laboratory****Description**

This facility provides nano- and atomic-scale analyses of materials using scanning tunneling microscopy and atomic force microscopy. The equipment can provide information on surface chemistry, bonding, atomic arrangements, and topography with ~ 0.1–100-nm spatial resolution. Specialized features include spectroscopic imaging techniques for specific atom imaging, atomic and nano-processing (including the manipulation of single atoms), and nano-scale characterization. Special emphasis is on the characterization and processing of semiconductors for photovoltaic applications.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

L.L. Kazmerski
Measurements and
Characterization Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1115

Ames Laboratory

Catalysis by Design

Description

Work focuses on understanding better how metal particles interact with reacting species such as automobile exhaust catalysts. The goal is to understand catalytic conversion of automobile exhausts to nontoxic products. Researchers examine theoretical aspects using predictive software to simulate the various properties of supported multimetallic catalysts. Experimental work validates these predictions via a variety of traditional catalytic techniques in combination with solid-state nuclear magnetic resonance (NMR). Catalytic behavior is then correlated with the determined properties.

Major laboratory capabilities include high-resolution solid-state NMR spectrometry used with catalytic reactors and a complete computer system with multiple work stations, sophisticated graphics capabilities, and extremely fast processing capabilities.

User Arrangements

Contact the Office for Planning and Technology Application.

Contact

Daniel E. Williams
Office for Planning and
Technology Application
Ames Laboratory
Ames, IA 50011
(515) 294-2635

National Renewable Energy Laboratory

Chemistry/Electrochemistry Laboratories

Description

These facilities are used to solve basic problems in the photo-electrochemistry of surface-modified semiconductor electrodes, conductive polymers, organometallic compounds, semiconductor particles, and liquid crystalline structures.

In addition, researchers can synthesize and characterize molecules that carry out light-induced charge separation and that catalyze useful chemical reactions.

Specific laboratories include photochemistry and photophysics, interfacial photochemistry, photoelectrochemistry synthesis and catalysis, and liquid crystal.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Michael Seibert
Basic Sciences Division
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1879

National Renewable Energy Laboratory

Optical Spectroscopy Laboratories

Description

These facilities are used to measure a variety of optical properties, including time-resolved absorption and emission spectra of materials used for photo-conversion processes.

Specific laboratories include photoconversion and spectrophotometry, nanosecond laser, and picosecond laser.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Michael Seibert
Photoconversion Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1879

National Renewable Energy Laboratory**Photobiology Laboratories****Description**

These facilities are used to study the microbiology, biochemistry, and genetics of oxygenic and anaerobic photosynthetic organisms.

Specifically, researchers can characterize metabolic and electron transport pathways, prepare and analyze photosynthetic membrane fractions and light active membrane-bound protein complexes that separate charge and split water, and develop light-driven biotechnology processes. A potential application is the bioproduction of hydrogen.

A test site is used to scale up photomicrobiological laboratory experiments for operation in natural sunlight.

The facilities include a growth room, photomicrobiology laboratory, biochemistry and membrane preparation laboratory, and a photobiological outdoor test site.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Michael Seibert
Photoconversion Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1879

Pacific Northwest Laboratory**Environmental and Molecular Sciences Laboratory****Description**

The facility allows researchers investigating basic chemical and physical processes to develop solutions to problems in environmental restoration and waste management.

The laboratory also provides the resources scientists need to understand the magnitude of the environmental problems, identify solutions, and provide better alternative strategies. The laboratory allows scientists to improve and expand their understanding of natural systems so they can develop innovative, less costly technologies.

Major capabilities include molecular science computing, molecular structure and dynamics, biomolecular structure and dynamics, environmental materials and interfaces, environmental simulation and modeling, and material synthesis and modeling.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Michael L. Knotek
Senior Science Director
Pacific Northwest Laboratory
Richland, WA 99352
(509) 375-2272

Brookhaven National Laboratory

Biochemical Process Laboratory

Description

This facility is used to study the bioremediation of contaminated soil and water, including metal-contaminated solids and sludges. One application of this work is the treatment of sludges produced in geothermal power plants.

Analytical equipment includes a gas chromatograph, a high-performance liquid chromatograph, an ion chromatograph, a gas chromatograph/mass spectrometer, an inductively coupled plasma mass spectrometer, and an electron paramagnetic resonance spectrometer.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Eugene Premuzic
Department of Applied Science
Brookhaven National Laboratory
Upton, NY 11973
(516) 282-2893

Idaho National Engineering Laboratory

Bioprocessing and Biotechnology Research Center

Description

This center is used to investigate unique biotechnological approaches to bioprocessing fossil fuels and minerals, recovering strategic materials, and remediating hazardous waste.

In the 1,115-m² (12,000-ft²), fully equipped laboratory and engineering scale-up space, research activities include molecular genetics, environmental microbiology, analytical biochemistry, biohydrometallurgy, and biochemical engineering.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Lamar J. Johnson
Center for Bioprocessing/
Environmental Technology
Idaho National Engineering Laboratory
Idaho Falls, ID 83415
(208) 526-1157

National Renewable Energy Laboratory

Anaerobic Microbiology Laboratory

Description

This facility is used to conduct and evaluate anaerobic fermentations as well as to characterize the anaerobic microbes and their respective enzyme systems. Researchers can also use the facility to develop genetic systems in a variety of anaerobic microbes including methanogens.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Chris Rivard
Applied Biological Sciences Branch
National Renewable Energy Laboratory
Golden, CO 80401
(303) 231-7631

National Renewable Energy Laboratory

Biochemistry and Genetics Facilities

Description

These facilities are used to identify, isolate, characterize, express, modify, and overproduce biocatalysts important for converting biomass to ethanol. The molecular biology and enzymology work is supported and extended by extensive pretreatment and fermentation resources.

Other work includes developing genetically engineered or modified cellulases through state-of-the-art recombinant technology or more classical genetic approaches.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Mike Himmel
Applied Biological Sciences
Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1799

National Renewable Energy Laboratory

Biotechnology Research and Development Center

Description

The center provides a national resource for obtaining research and engineering data to support the commercialization of biotechnology-based processes for the production of health-care products, specialty chemicals, commodity chemicals, agricultural products, fuels and biological waste treatment.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Charles Wyman
Bioprocess and Fuels
Engineering Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1753

National Renewable Energy Laboratory

Microalgal Biotechnology Laboratories

Description

These facilities are used for the genetic engineering of microalgae, other aquatic species, and higher plants for fuel production and carbon dioxide uptake. A greenhouse and extensive lipid analysis equipment are available. In addition, the facilities contain one of the world's most extensive collections of industrially important microalgae.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Lewis Brown
Applied Biological Sciences
Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1321

Brookhaven National Laboratory

**Combustion Equipment
Technology Laboratory**

Description

This facility is used to test the efficiency and emissions of oil-fired furnaces and boilers under varied operating conditions. The facility is also used to test the characteristics of fuel-oil nozzles and the effects of condensing economizers on the efficiency and emissions of oil-, gas-, and coal-fired boilers.

The facility includes three 158 MJ/h (150,000 Btu/h) hydronic boilers, one 158 MJ/h (150,000 Btu/h) warm-air furnace, and one 2110 GJ/h (2,000,000 Btu/h) commercial boiler. Emissions analyzers measure CO₂, CO, NO_x, SO_x, and the total mass and size distribution of particulates. For fuel-oil nozzles, drop-size distributions can be determined from a laser-based spray analyzer.

User Arrangements

Contact the laboratory managers.

Laboratory Managers

Roger McDonald or
Thomas Butcher
Department of Applied Science
Brookhaven National Laboratory
Upton, NY 11973
(516) 282-4197 or 7916

Florida Solar Energy Center

**Appliance Laboratory and
Training Center**

Description

This facility is used to test demand-side management technologies by imposing characteristic residential electrical loads on typical or innovative household appliances.

The facility houses control systems, a variety of appliances (cold and warm water storage systems and refrigerator-freezers), and automated data acquisition instrumentation. The facility also has four 153-m³ (1800-ft³) environmental chambers that can control environments with a total maximum internal load of 4535 kg (5 tons) (63.3 MJ/h [60,000 Btu/h]). Controlled temperatures range from -7° to 49°C (20° to 120°F), and controlled humidity from 20% to 100% relative humidity.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Charles Cromer
Florida Solar Energy Center
Cape Canaveral, FL 32920
(407) 783-0300 x219

Florida Solar Energy Center

**Building Envelope
Technology Facilities**

Description

Several facilities are used to analyze and test buildings and building components. The Building Design Assistance Center is used to analyze energy use in commercial buildings in the design phase.

The Passive Cooling Laboratory is used to test components used in passively cooled buildings. Researchers can configure test spaces within the facility to meet specific experimental requirements. Each test space is thermally isolated from the others.

An environmental control chamber is used to evaluate moisture sorption phenomena in building materials and furnishings. The chamber produces and sustains interior temperature conditions between -7° and 49°C (20° and 120°F) with coincident moisture conditions between 6% and 95% relative humidity.

The Diurnal Test Facility is used to study roof-integrated cooling strategies that incorporate desiccant materials. The effects of solar heating and nocturnal cooling potentials are simulated and measured in a controlled indoor environment.

Researchers can use the Radiant Barrier Test Facility to investigate the long-term thermal and material performance of radiant barriers in six side-by-side attic spaces that are instrumented to measure ceiling temperature flux and air temperatures.

(continued)**User Arrangements**

Contact the laboratory manager.

Laboratory Manager

Subrato Chandra
Florida Solar Energy Center
Cape Canaveral, FL 32920
(407) 783-0300 x198

Florida Solar Energy Center**Cooling Equipment Facilities****Description**

Two facilities are used to test the operating performance of cooling equipment used in buildings. One facility is used to test the operating performance of chilled water and ice storage systems and heat-pipe-enhanced air-conditioners.

Another facility is used to test fixed-speed and adjustable speed air-conditioners and heat pumps in either the cooling or heating mode. The facility is also used to test desiccant-enhanced systems. Testing is done under precisely controlled temperature, humidity, and air flow conditions. The facilities house three environmental chambers.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Don Shirey
Florida Solar Energy Center
Cape Canaveral, FL 32920
(407) 783-0300 x190

Florida Solar Energy Center**Solar Collector and System Test Facilities****Description**

The Solar Collector Test Station is used to measure the thermal performance of solar water heating collectors. The station's sun-tracking test stands are equipped with controls and instrumentation. The station is the only certified solar water heating collector test facility in the nation.

The Solar System Laboratory is used to conduct side-by-side tests of a variety of solar system designs and plumbing configurations. The facility comprises an external array of solar thermal collectors and an internal laboratory with water tanks and associated plumbing and controls.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Jim Roland
Florida Solar Energy Center
Cape Canaveral, FL 32920
(407) 783-0300 x163

Lawrence Berkeley Laboratory

Advanced Materials Laboratory

Description

This facility is used to identify, characterize, and develop promising new optical materials for use in advanced fenestration systems. Specific projects include durable solar-control and low-emittance coatings, low-conductance glazings and "superwindows," optical switching devices, core daylighting system design, automobile glazings, and insulation.

Equipment includes an IBM nanoindenter and a computer to model window and building systems.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Mike Rubin
Energy and Environment
Division
Lawrence Berkeley Laboratory
Berkeley, CA 94720
(510) 486-7124

Lawrence Berkeley Laboratory

Compact Fluorescent Laboratory

Description

This facility is used to develop the technology and applications of compact fluorescent lamps. This research directly serves the lamp and fixture industry.

To assist manufacturers, the facility activities include technical assistance and information, economic analysis and conservation projections for retrofit programs, demonstration of lamp-fixture applications, advanced fixture design and recommendations, photometric analysis and efficiency studies, life testing and system durability, and development of testing protocols.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Michael Siminovitch
Energy and Environment
Division
Lawrence Berkeley Laboratory
Berkeley, CA 94720
(510) 486-5863

Lawrence Berkeley Laboratory

Environmental Chamber

Description

This facility is used to investigate emissions of indoor sources and pollutants in a controlled chamber that simulates typical indoor environmental conditions.

The chamber is the size of a typical room. The walls, floor, and ceiling are insulated with a 10-cm layer of high-density polyurethane foam. The chamber is equipped with a single-pass ventilation system. A variable-speed blower draws inlet air from outside the laboratory that passes through a coarse filter, a HEPA filter, and a charcoal filter in series. Air is exhausted outdoors.

Researchers can vary the air exchange rates from about 0.5 to 10 air changes per hour and temperatures from about 15° to 30°C. Temperatures can be held within $\pm 1^\circ\text{C}$ for more than a week; relative humidity is usually held at about $50\% \pm 1.5\%$.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Joan Daisey
Energy and Environment
Division
Lawrence Berkeley Laboratory
Berkeley, CA 94720
(510) 486-7491

Lawrence Berkeley Laboratory**Infrared Thermography Laboratory****Description**

Infrared thermography is used to improve the thermal performance of window frames and edge systems. An experimental technique, the system produces two-dimensional heat transfer information in the form of a temperature contour map.

The facility houses a cold chamber where a window specimen is mounted in the opening. One side is exposed to the cold chamber (between -30° and 0°C); the other to an ambient temperature of about 20°C. An imaging scanner captures a thermographic image, or thermogram, of the window surface. The thermogram can be converted to surface temperature information and further processed using computer hardware and software.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Fredric Beck
Energy and Environment
Division
Lawrence Berkeley Laboratory
Berkeley, CA 94720
(510) 486-4437

Lawrence Berkeley Laboratory**Mobile Window Thermal Test Facility****Description**

This calorimetric facility (MoWiTT) is used to measure the performance of vertical or horizontal fenestration systems under actual weather conditions.

MoWiTT consists of a pair of room-sized, guarded calorimeters mounted side by side in a mobile structure. Each calorimeter may accept a vertical system up to 2.3 m² (25 ft²) or a horizontal system up to 1.2 m² (13 ft²) for study. The calorimeter rooms measure 2.4-m (8-ft) high by 2.4-m (8-ft) wide by 3.0-m (10-ft) long. MoWiTT is currently based at Reno, Nevada, where both winter and summer measurements are made, although other locations are possible. Measurements can be monitored remotely.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Joseph H. Klems
Energy and Environment
Division
Lawrence Berkeley Laboratory
Berkeley, CA 94720
(510) 486-5564

Lawrence Berkeley Laboratory**Scanning Radiometer Laboratory****Description**

The scanning radiometer is used to measure the bidirectional transmittances and reflectances of various types of window shades to determine the solar heat gain coefficients. These coefficients are key to analyzing residential and commercial building energy performance.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Joseph H. Klems
Energy and Environment Division
Lawrence Berkeley Laboratory
Berkeley, CA 94720
(510) 486-5564

Lawrence Berkeley Laboratory

Sky Simulation Facility

Description

This hemispherical artificial sky is used to recreate luminous distributions typical of clear, uniform, or overcast skies representative of any desired location, orientation, climate, and season. The hemisphere can also simulate the effects of direct sun and ground-reflected light.

The hemisphere is 7.3 m (24 ft) in diameter, and the light sources within the hemisphere are electronically controlled. The hemisphere can accommodate scale models of buildings up to 40 cm² (4 ft²). Light levels within the models are measured by 60 photosensors, and the measurements are used to predict daylight illuminance conditions within full-sized buildings.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Joseph H. Klems
Energy and Environment
Division
Lawrence Berkeley Laboratory
Berkeley, CA 94720
(510) 486-5564

Los Alamos National Laboratory

Thermoacoustic Engine Design Facility

Description

This facility examines the use of high-amplitude acoustics to eliminate compressors and other moving parts in refrigeration and air-conditioning systems. Thermoacoustic engines serve as both compressors and heat exchangers because the heat exchange generates acoustic waves.

Facilities include fully instrumented chilled and heated water loops and gas handling systems for the refrigerants. Also available is a verified design and analysis computer code, the Design Environment for Linear Thermoacoustic Engines.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Greg Swift
Los Alamos National Laboratory
Los Alamos, NM 87345
(505) 665-0640

National Institute of Standards and Technology

Building and Fire Research Laboratory: Calibrated Hot Box Facility

Description

This facility is used to measure the air, heat, and moisture transfer in full-scale building wall sections.

The facility consists of two large, heavily insulated chambers—an environmental chamber and a climatic chamber—each with one open side. The open test section measures 3 × 4.6 m (10 × 15 ft). A well-insulated frame supports the wall specimen, which is clamped between the open sides of the two chambers.

The facility provides dynamic and static temperature, humidity, and air movement that simulate a wide range of climatic conditions. Temperatures range from -40° to 65°C (-40° to 150°F). The hot box measures the performance of homogeneous or composite walls having a range of thermal resistance from 0.35 to 8.8 m²·°C/W and accommodates wall specimens up to 0.6-m (2-ft) thick and 700 kg/m² (143 lb/ft²) in weight per unit area.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

A. Hunter Fanney
Building and Fire Research
Laboratory
National Institute of Standards
and Technology
Gaithersburg, MD 20899
(301) 975-5864

National Institute of Standards and Technology

Building and Fire Research Laboratory: Large Environmental Chamber

Description

This chamber, one of seven, is used to measure indoor temperature fluctuations, heat loss, and heat gain through building envelopes; energy conservation and moisture condensation; and air infiltration under simulated and dynamically fluctuating outdoor temperature cycles. Researchers can test the thermal performance of various conventional and special structures and equipment, including lighting systems and heating, ventilating, and air-conditioning equipment under different design and operating conditions.

The chamber measures $14.9 \times 12.8 \times 9.5$ m high ($49 \times 42 \times 31$ ft high) and can accommodate two-story houses. It has an earth floor that can be excavated as needed for building construction. It automatically maintains steady or dynamic temperature profiles from -45° to 65°C (-50° to 150°F) and humidity from 50% relative humidity at 1.7°C (35°F) to 35°C (95°F) dewpoint at 49°C (120°F).

User Arrangements

Contact the laboratory manager.

Laboratory Manager

David A. Didion
Building and Fire Research
Laboratory
National Institute of Standards
and Technology
Gaithersburg, MD 20899
(301) 975-5881

National Institute of Standards and Technology

Building and Fire Research Laboratory: Light/HVAC Interaction Facility

Description

This facility is used to evaluate the interaction between different types of lighting systems and heating, ventilating, and air-conditioning (HVAC) systems in a precisely controlled environment that simulates an interior office.

The laboratory contains guarded air spaces on four sides and an upper and lower plenum. Luminaires installed in the lower plenum simulate lighting loads and heat flows from an office directly below. The chamber has a reconfigurable HVAC system in which users can easily modify the type and location of the diffusers. It is fully instrumented to allow up to 400 simultaneous measurements of the thermal lighting conditions every 2 minutes. One wall of the chamber can be modified to simulate an exterior window wall with access to a solar simulator.

Researchers can readily study the type and position of luminaires, the type and number of light sources, the pattern and volume of air flow, and the schedule of operation. Exterior conditions can be varied from 0° to 50°C .

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Stephen J. Treado
Building and Fire Research
Laboratory
National Institute of Standards
and Technology
Gaithersburg, MD 20899
(303) 975-6444

National Institute of Standards and Technology

Building and Fire Research Laboratory: Line-Heat- Source Guarded Hot Plate

Description

This facility is used to measure the thermal conductivity building insulation to thicknesses of 40 cm (1.3 ft).

The apparatus used is a 1-m (3.3-ft) guarded hot plate with a test temperature range between 80°C (175°F) (the hot plate) and -20°C (-4°F) (the cold plate). Researchers can measure vertical and horizontal flow to simulate the heat transfer through ceilings and walls. The hot plate provides for absolute measurement of thermal resistance of thick and low-density test specimens used as transfer standards.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Robert A. Zarr
Building and Fire Research
Laboratory
National Institute of Standards
and Technology
Gaithersburg, MD 20899
(301) 975-6436

**National Institute of Standards
and Technology**

**Building and Fire Research
Laboratory: Outdoor Energy
Conservation Laboratory**

Description

This facility is used to measure the thermal performance of solar building features and to test individual components. Single-room test houses provide data on dynamic mass effects and heat exchange with the surrounding earth.

The facility includes a multiroom passive solar test building containing more than 400 sensors and transducers, clerestory windows, a mass storage wall, a direct-gain cell, and a passive solar calorimeter test apparatus. In addition, there are six single-room test houses, each constructed with different materials and insulation thicknesses.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

A. Hunter Fanney
Building and Fire Research
Laboratory
National Institute of Standards
and Technology
Gaithersburg, MD 20899
(301) 975-5864

**National Institute of Standards
and Technology**

**Building and Fire Research
Laboratory: Solar Hot Water
Test Facility**

Description

The test facility is used to test up to six solar hot water systems simultaneously. The tests provide data for computer model developers and for numerous national and international performance validation efforts. The test facility was used to develop techniques to predict long-term performance of integral collector storage and thermosyphon systems from short-term test results. It is also used to conduct experiments to determine the relationship between flow rates and thermal performance of solar hot water systems.

The test facility includes two computer-based data acquisition systems, an apparatus to maintain a given water supply temperature, and racks to mount collectors above and below the floor level. Each data acquisition system provides 60 channels of measurement capability and can control experimental apparatus through digital output channels. Inlet temperature to the hot water systems being tested can be selected through a fluid conditioning apparatus.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

A. Hunter Fanney
Building and Fire Research
Laboratory
National Institute of Standards
and Technology
Gaithersburg, MD 20899
(301) 975-5864

National Renewable Energy Laboratory

**Desiccant Cooling
Laboratory**

Description

This facility is used to investigate the performance of various components and configurations used in desiccant cooling systems. Specific tasks include investigating the long-term effects of air pollutants on the degradation of desiccant materials used in cooling equipment; measuring the transient heat and mass exchange performance of desiccant matrices (desiccant material arrayed in various configurations); measuring moisture capacity of desiccant materials at various relative humidities and temperatures; and measuring the performance of heat and moisture transfer of heating, ventilating, and air-conditioning equipment, specifically desiccant humidifier wheels and heat pipes.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Ahmad Pesaran
Thermal Systems Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-7636

National Renewable Energy Laboratory**Whole Building Test Facility****Description**

This facility is used for basic turbulent flow, room air motion, indoor air quality, and human comfort research. In addition, researchers are investigating demand-side management and new technologies that result in reduced energy consumption. The facility is a one-story 457-m² (1550-ft²) building. The building's layout makes it easy to simulate different air and contaminant distribution problems that may arise in office buildings.

This facility contains accurate and reliable instrumentation such as a unique flow imaging system, a hot-wire anemometry system, a Laser-Doppler system, and high-speed computers for image and data processing.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Vahab Hassani
Thermal Systems Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-7064

Oak Ridge National Laboratory**Refrigeration/Heat Pump Equipment Laboratory****Description**

A large, two-room environmental chamber is available for testing refrigeration, air-conditioning, and heating systems. Users can control dry-bulb and dew-point temperatures and relative humidity in each room.

Calorimeters rated for 53 kJ/h–19 MJ/h (50–18,000 Btu/h) and 105 kJ/h–3 MJ/h (100–3000 Btu/h) are used to measure the performance of test compressors. The temperature in an environmental chamber surrounding the compressor can vary from -80° to 177°C (-112° to 350°F).

A small capacity breadboard test loop generates vapor-compression cycle performance data on alternative refrigerants. A breadboard water-to-water vapor compression test apparatus is used to study nonazeotropic refrigerant mixtures. A breadboard test stand evaluates advanced vapor compression cycle options for refrigerator-freezers. Users can also test ice storage and air-refrigerant heat exchangers.

User Arrangements

Prospective users may negotiate guest assignments, work-for-others agreements, or cooperative research and development agreements.

Laboratory Manager

Van D. Baxter
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-2104
FAX (615) 574-9338

Oak Ridge National Laboratory**Thermally Activated Heat Pump Laboratory****Description**

This facility is used to test absorption heat- and mass-transfer components and working fluids used in heat pumps. The facility has two test stands available for testing components of absorption heat pumps that use ammonia-water and lithium bromide water as the working fluids. Testing goals are to improve overall system performance and downsize the absorber.

The ammonia-water absorber test stand is used to test heat- and mass-transfer characteristics of ammonia-water-based solutions. The test heat exchanger installed in the loop is a wound coil made of low carbon steel with 58 turns (outside tube diameter is 1.3 cm [0.5 in.], and the coil diameter is 11.4 cm [4.5 in.] between centers). Automated electrochemical corrosion instruments are available.

The lithium bromide-water rig consists of a data acquisition system and a heat- and mass-transfer test stand that can test either vertical or horizontal absorber tubes. The vertical and horizontal absorbers can test a single tube or tube bundle. All line connections to the absorbers are fabricated from 304-L stainless steel, and a mass spectrometer is used to check for leaks. The rate is certified at less than 1.0×10^7 atm/cm³ · s. The vertical absorber is made of Pyrex glass, and the horizontal absorber has Pyrex glass end plates so researchers can see the falling film.

(continued)

User Arrangements

Contact the laboratory managers to negotiate guest assignments, work-for-others agreements, or cooperative research and development agreements.

Laboratory Managers

William Miller or Abdi Zaltash
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-2013

Pacific Northwest Laboratory

Energy Metering Laboratory

Description

This facility is used to measure energy flows and determine the efficiencies of equipment typically found in buildings. Capabilities include energy characterization of individual equipment, specific end uses, whole buildings, distribution systems, and whole facilities.

Specifically, staff members evaluate electrical distribution systems; heating, ventilating, and air-conditioning systems sizing and control strategies; steam, high-temperature hot water, and chilled water distribution systems; and lighting systems and levels. Staff members also determine electric power quality; motor, pump, and compressor efficiency; boiler combustion and delivery efficiency; and chiller delivery efficiency.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Richard F. Szydlowski
Applied Physics Center
Pacific Northwest Laboratory
Richland, WA 99352
(509) 375-3753

Argonne National Laboratory**Electrochemical Technology Facilities****Description**

These facilities are used to resolve key technical issues associated with advanced battery and fuel cell technologies used in electric vehicles. Researchers examine cells, stacks, and battery systems to identify performance and life-limiting features. This is critical feedback for hardware development projects.

The facilities house specialized electrochemical-characterization equipment combined with controlled-atmosphere glove boxes used in handling and testing reactive electrode and cell materials. Researchers can use any of more than 60 test stations to evaluate cells, stacks, modules, and full-sized batteries under simulated-use conditions.

User Arrangements

Contact the laboratory managers.

Laboratory Managers

Kevin M. Myles or
Clint Christianson
Chemical Technology Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-4329 or 7563

Idaho National Engineering Laboratory**Electric Vehicle Testing Laboratory****Description**

This facility is used to test electric and hybrid vehicles and related energy storage and propulsion technologies such as batteries, capacitors, and electric drive trains.

The facility houses a chassis dynamometer that can measure the energy output of vehicles up to 52 kW (70 hp) and vehicles that weigh up to 4540 kg (10,000 lb). Other equipment includes complex power measurement instrumentation, multichannel data systems, programmable battery charge/discharge testers up to 500 V at 500 amps, a 1.8 × 2.4 m (6 × 8 ft) temperature chamber with temperatures ranging from -20° to 80°C (-4° to 176°F), and a vibration table.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Gary L. Hunt
Transportation and
Renewable Energy Programs
Idaho National Engineering
Laboratory
Idaho Falls, ID 83415
(208) 526-1095

Sandia National Laboratories**Battery Dry Rooms and Prototype Fabrication Laboratories****Description**

These facilities are used to make prototype cells and batteries used in electric vehicles and to analyze the causes of battery failure.

Facilities include two dry rooms that contain powder processing equipment, pellet fabrication presses, welding equipment, and a scanning electron microscope for post-test analysis. A laboratory used for handling liquid electrolytes contains equipment to fill cells remotely. Facilities also include material preparation laboratories.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Bob Clark
Battery Projects and
Engineering Programs
Sandia National Laboratories
Albuquerque, NM 87185
(505) 844-6332

Sandia National Laboratories

**Battery Test and Evaluation
Laboratories**

Description

This facility provides performance data on primary and secondary batteries and battery modules used in electric vehicles under various conditions of electrical load and environment.

Equipment in this facility includes 76 test stations for rechargeable batteries with maximum voltages to 200 V, currents to 200 A, and power to 20 kW. Load profiles for primary batteries can range from less than 1-s duration with millisecond load control to test periods of years. Testing can be conducted in dynamic environments (shock, vibration, and acceleration) and static environments (temperature).

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Bob Clark
Battery Projects and
Engineering Programs
Sandia National Laboratories
Albuquerque, NM 87185
(505) 844-6332

Argonne National Laboratory**Acoustic Leak Detection Laboratory****Description**

This facility is used to study the acoustic methods for detecting and locating steam and gas leaks. Users can also develop instrumentation to detect and locate steam and gas leaks at temperatures up to 177°C (350°F) and pressures up to 1380 kPa (200 psi) in the field.

This is valuable to the district heating and cooling industry. Spectral and cross correlation analysis of acoustic leak signals is performed on signal processing equipment.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

David S. Kupperman
Materials and Components
Technology Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-5108

Argonne National Laboratory**Flow and Heat Transfer Test Facility****Description**

This facility is used to study the complex single-phase and multiphase flow and transport processes that occur in thermal systems and the components of which they are composed.

The laboratory consists of three facilities. A large, computer-controlled 127 L/s (2000 gal/min) water loop can simulate thermal-hydraulic transients as well as steady-state conditions. The Slurry Flow Facility is used to study pressure drop and heat transfer to melt and solidify energy transmission slurries using a 2000-frame/s digitizing video system. The Flow Rheology Center has a computerized rotating-member viscometer, a high-pressure capillary tube, and falling-needle viscometers.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Kenneth E. Kasza
Materials and Components
Technology Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-5920

Los Alamos National Laboratory**Fuel Cell Facility****Description**

This facility is used to develop a fuel cell power system for transportation. Under development is a proton-exchange membrane fuel cell. Currently, researchers are producing an integrated, transportable system consisting of a 10-kW fuel cell, a methanol fuel processor, a battery, and controls to be used in an electric vehicle.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Gerald Maestas
Industrial Partnership Center
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 667-3973

Pacific Northwest Laboratory

**Electromagnetic-Field
Characterization Laboratory**

Description

This facility is used to produce and characterize electric currents and electromagnetic fields.

The instrumentation has a primary DC frequency range to 100 kHz and limited capabilities to 1 GHz.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Don Boyd
Applied Physics Center
Pacific Northwest Laboratory
Richland, WA 99352
(509) 375-2149

Pacific Northwest Laboratory

**Electromagnetic-Field
Exposure Facility**

Description

This facility is used to determine the possible effects on human health of exposure to electromagnetic fields.

The facility houses electromagnetic exposure systems that can test 600 animals. The equipment can produce multiwaveform exposure, and its field calibration is traceable to the National Institute for Standards and Technology. Users can do both *in vivo* and *in vitro* studies and behavioral and neural endocrine studies.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Larry Anderson
Life Science Center
Pacific Northwest Laboratory
Richland, WA 99352
(509) 375-2294

Argonne National Laboratory**Small Channel Flow and Heat-Transfer Test Facility****Description**

This facility is used to study two-phase flow and phase-change heat transfer in small, typically non-circular, test channels.

The facility houses a two-phase flow test apparatus and a flow boiling test apparatus. The former is used for adiabatic tests with two-component, gas-liquid mixtures. Researchers can observe flow patterns through a transparent wall in the test channel, and instrumentation allows for pressure drop measurements. The flow boiling test apparatus is used to study flow boiling of refrigerants in small channels. This apparatus includes a Hewlett Packard data acquisition system consisting of a microcomputer and a data acquisition/control unit.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Martin W. Wambsganss
Materials and Components
Technology Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-6144

Argonne National Laboratory**Thermal Sciences Fouling Test Facility****Description**

This facility is used to determine fouling deposition for plain and enhanced surfaces. A long-term objective is to develop measurement techniques to determine the controlling mechanisms in fouling of heat- and mass-transfer equipment including membranes. Researchers can determine the local rate of fouling deposition for organic fluid and for cooling water applications.

The facility houses a heat-transfer monitor to measure cooling-water fouling in the laboratory and in the field. Another apparatus is used to measure organic-fluid fouling at temperatures up to about 200°C. Test equipment being planned will include one for high-temperature 400°–500°C organic-fluid fouling measurements for field experiments and optical and liquid-crystal techniques to determine the fouling phenomena near the wall surface.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

T. Marciniak
Energy Systems Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-7895

Oak Ridge National Laboratory**Environmental Testing Chamber****Description**

This test chamber is used to test the performance of automobile air-conditioning systems. An air-conditioning system uses the two chamber rooms to simulate passenger compartment and outdoor environments. The heat-exchanger fans and compressor are driven by variable speed motors, enabling the user to simulate variable driving conditions.

Current experiments are aimed at optimizing the design of automobile air conditioning systems with R134a for maximum energy efficiency. Other planned experiments include testing methods for automatically monitoring the refrigerant charge and recovering the heat of vaporization from the liquid water produced during dehumidification.

User Arrangements

Contact the laboratory manager to negotiate guest assignments, work-for-others agreements, or cooperative research and development agreements.

Laboratory Manager

Fang Chen
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-0712

Oak Ridge National Laboratory

Fuels, Combustion, and Propulsion Technology Laboratory

Description

This facility is used to evaluate alternative fuel emission controls, advanced materials, and related technologies for combustion engines.

Equipment includes emissions measurement equipment, fixtures for in-engine exposure of standard ceramic test coupons, bench heat-transfer rigs, four engine dynamometers with 17–298 kPa (25–400 hp) capacity, and a high-speed data acquisition system.

User Arrangements

Contact the laboratory manager to make arrangements or to negotiate a cooperative research and development agreement.

Contact

Ronald L. Graves
Engineering Technology Division
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-2036
FAX (615) 574-2102

Pacific Northwest Laboratory

Fluid Dynamics Laboratory

Description

This facility is used to study the behavior of complex fluids in processing applications. Complex fluids include solid-liquid mixtures, non-Newtonian fluids, and colloidal suspensions. These studies, which are supported by computational fluid dynamics modeling, attempt to validate predictive tools to evaluate processes and to scale up systems involving complex fluids.

Major equipment includes state-of-the-art nonintrusive flow measurement systems such as particle image velocimetry and scaled cylindrical vessels for mixing and solids resuspension studies (up to 5.7 m in diameter), including 189 and 378 L/min (100 and 500 gal/min) pumps and pumps that can pump slurries. Additional equipment includes experimental apparatus for conducting multiphase turbulence studies, a high-resolution infrared camera, and a high-speed data acquisition system.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Nick Lombardo
Applied Physics Center
Pacific Northwest Laboratory
Richland, WA 99352
(509) 375-3644

Pacific Northwest Laboratory

Process Science and Engineering Complex: Chemical Process Development Laboratory

Description

This facility is used for high-moisture feedstock gasification, organic destruction, gas processing, high-pressure separation studies, kinetic studies, catalyst evaluation, and process scale-up information development.

The 93-m² building houses analytical equipment, a fume hood, and three high-pressure reactor systems. The systems are a 1-L stirred Inconel batch autoclave that operates at 350 atm and 450°C, a 1-L continuous Carberry stirred-tank reactor system, and a 2 L/h stainless-steel continuous flow tubular reactor system that operates at 270 atm and 400°C.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Rod Quinn
Materials and Chemical Sciences Center
Pacific Northwest Laboratory
Richland, WA 99352
(509) 375-6625

Pacific Northwest Laboratory**Process Science and Engineering Complex: Chemistry and Metal Science Laboratories****Description**

These facilities are used for separations and process chemistry at both laboratory and engineering scale. Typical activities include organometallic catalyst synthesis, evaluation of combined catalysis/separation, organic and polymer analyses, electrokinetic separations, electrodialysis, and electrochemical ion exchange.

Equipment includes a Schlink line and glove box, a membrane reactor, several gas chromatographs and detectors, mass spectrometers, and a test cell for electrochemical research and processing.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Rod Quinn
Materials and Chemical
Sciences Center
Pacific Northwest Laboratory
Richland, WA 99352
(509) 375-6625

Sandia National Laboratories**Burner Engineering Research Laboratory****Description**

This facility is used by manufacturers, users, and researchers to study combustion in industrial-scale natural gas burners (up to 900 kW). The mission of the facility is to develop engineering insight and the fundamental understanding of combustion in practical natural gas burners and transfer this information to gas industry applications.

Conventional diagnostics are made available to users including gas sampling and suction pyrometry and laser diagnostics including planar Mie scattering, laser Doppler velocimetry, fluorescence, degenerate four-wave mixing, and coherent anti-stokes Raman spectroscopy.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Neal Fornaciari
Combustion Applications
Sandia National Laboratories
Livermore, CA 94551
(510) 294-2472

Florida Solar Energy Center

Alternative Fuels Facilities

Description

The Hydrogen Laboratory is used to produce hydrogen photoelectrochemically and to develop hydrogen storage technologies. Equipment includes a gas chromatograph with automatic injection; a high-pressure, high-temperature thermogravimetric analyzer; a scanning electron microscope; and a solid-polymer hydrogen generator.

In the Alternative Fuels Laboratory, a 298-kPa (400-hp) engine dynamometer is used to test engines using the hydrogen fuel. Capabilities include in-cylinder pressure and temperature analysis.

The Photovoltaics Electrolysis Laboratory is used to generate hydrogen for use as a fuel. The laboratory is equipped with a 24-m (80-ft) parabolic concentrator and six distributed electrolyzers to produce hydrogen from water.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Kirk Collier
Florida Solar Energy Center
Cape Canaveral, FL 32920
(407) 783-0300 x217

National Renewable Energy Laboratory

**Biomass Conversion/
Organic Synthesis
Laboratories**

Description

These facilities are used to investigate novel methods for electric power generation and for the transformation of renewable and biomass-derived material into useful fuels and chemicals. A complete analytical facility for biomass analysis is available.

Organic and organometallic synthesis, electrochemical synthesis, and catalysis are used to analyze the composition of biomass feedstocks.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Managers

Joe Bozell or David Johnson
Chemical Technologies
Research Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-7376 or 7633

National Renewable Energy Laboratory

**Pilot Plant/Integration
Facility**

Description

This area is used to convert biomass feedstocks to ethanol. A 907-kg/day (1-ton/day) biomass-to-ethanol pilot plant is scheduled to begin operating in mid-1994; a bench-scale unit will be operational in August 1993. The pilot plant will feature equipment for pretreating biomass feedstocks, several large-scale (8500 L) fermenters for producing cellulase and converting cellulose and xylose to ethanol. A distillation column for product recovery will also be available. The bench-scale unit will also have pretreatment equipment, fermenters, and a distillation column. Both systems will have extensive data acquisition capabilities.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Barbara Goodman
Bioprocess and Fuels
Engineering Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1005

National Renewable Energy Laboratory**Pretreatment Laboratory****Description**

Researchers use this facility to investigate alternative bench-scale pretreatment processes using herbaceous and woody biomass feedstocks. The facility features a pilot-scale (90-L) pretreatment reactor, a novel pretreatment percolation reactor, and several other batch pretreatment reactors.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Barbara Goodman
Bioprocess and Fuels
Engineering Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1005

National Renewable Energy Laboratory**Pyrolysis Engineering Laboratory****Description**

This facility is used to produce pyrolysis oil from biomass and waste feedstocks, employing an engineering-scale fast-pyrolysis process. This pilot facility operates at 22.5 to 31.8 kg/h (50 to 70 lb/h). Oils can be used as feedstocks for fuels, for the production of chemicals, or for the generation of electric power. Associated facilities are available for chemical fractionation of the oils and catalytic upgrading. The laboratory also has complete analytical facilities for characterization and upgrading.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

John Scahill
Chemical Technologies
Research Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1346

National Renewable Energy Laboratory**Saccharification and Fermentation Laboratories****Description**

These facilities are used to research biologically based processes for converting municipal and agricultural biomass wastes and dedicated energy crops into useful fuels and chemicals.

Specifically, researchers use fermentation to produce enzymes, chemicals, and fuels; microbiology to screen, isolate, cultivate, and improve genetic strains; and analytical chemistry to identify and quantify chemicals.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Barbara Goodman
Bioprocess and Fuels
Engineering Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1005

Pacific Northwest Laboratory

**Process Science and
Engineering Complex:
Chemical Engineering
Laboratory**

Description

This facility is used to upgrade pyrolysis oils and synthetic liquid fuels.

The 85-m² facility houses a fixed-bed 1-L catalytic hydrotreater that can process up to 1 L/h of liquid feedstock at 400°C and 135 atm. Two gasification/pyrolysis reactors are located outside the facility on a 50 × 30-m concrete pad. These reactors consist of a 30-cm-diameter by 2-m-high fixed-bed gasifier and a 30-cm-diameter by 3-m-high fluidized-bed gasifier that can operate to a pressure of 10 atm. The facility also has two 945-L pilot-scale fermenters.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Rod Quinn
Materials and Chemical
Sciences Center
Pacific Northwest Laboratory
Richland, WA 99352
(509) 375-6625

Idaho National Engineering Laboratory**Heat-Cycle Research Facility****Description**

This facility, located in California's Imperial Valley, is dedicated to investigating heat-transfer properties and turbine operations used in geothermal power conversion systems. These investigations are aimed at improving the efficiency of binary heat cycles using organic working fluids.

The facility is essentially a small binary power plant, which includes supercritical heaters, a counter-current condenser, a turbine, a motor generator, and ancillary piping and equipment.

The facility is designed for all types of binary heat-cycle studies but is specially suited for supercritical operations. The system includes a test nozzle with a laser droplet detection system. The condenser can also be operated at nonvertical orientations.

User Arrangements

Contact the program manager.

Program Manager

Gregory L. Mines
Transportation and
Renewable Energy Programs
Idaho National Engineering
Laboratory
Idaho Falls, ID 83402
(208) 526-9895

Los Alamos National Laboratory**Deep Wellbore Test Resource****Description**

The borehole is used to evaluate the feasibility of generating electricity from hot dry rock. The borehole is 3,048 m (10,000 ft) deep, lined to 2,925 m (9600 ft) with casing that has an inside diameter of 22.2 cm (8.75 in.), and encased in granite 21.6 cm (8.5 in.) in diameter to its total depth. It is filled with water and has a bottom hole temperature of 200°C (392°F). The data generated are available to outsiders.

User Arrangements

Contact the laboratory manager. Preference will be given to research in which Los Alamos staff collaborates or that supports Los Alamos programs. Use of this facility is on a noninterference basis, and any incremental costs are negotiated case by case.

Laboratory Manager

James N. Albright
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 667-4318

Los Alamos National Laboratory**Hot Dry Rock Test Facility****Description**

This test facility was built to evaluate the possibility of using the heat found at depth in dry rock as an energy source for practical applications.

The facility consists of two wellbores 3,650 m (12,000 ft) deep. The wellbores terminate roughly 90 m (296 ft) apart in a 220°C (428°F) fractured-rock reservoir.

Two high-pressure pumps capable of pumping 15 L/s (4 gal/s) each at pressures up to 3447 N/cm² pump water down the "injection" wellbore. Hot water returning up the "production" wellbore is routed through a gas particle separator and a 100-MW-capacity air-cooled heat exchanger. Makeup water pumps replace any lost water before the cool water is reinjected.

The plant is fully instrumented and includes a fully automated interrogation and control system.

User Arrangements

Contact the program manager.

Program Manager

David V. Duchane
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 667-9893

Sandia National Laboratories

Wellbore Hydraulics Flow Facility

Description

This facility simulates the flow of drilling fluids into and out of a wellbore during drilling to evaluate and develop flow meters that track fluid movement. The research has applications in geothermal drilling.

Equipment includes a 3785-L/min (1000-gal/min) slurry pump capable of pumping drilling muds with entrained solids; a simulated wellbore with pipe down-flow and annular up-flow; a 3.7-m (12-ft) return line that can be inclined from 0 to 12.5 deg from the horizontal; a 1136-L (300-gal) mud tank; a diaphragm control valve; a mud mixing system; and a data acquisition system.

User Arrangements

Contact the laboratory managers.

Laboratory Managers

David A. Glowka or
Diane M. Schafer
Geothermal Research
Sandia National Laboratories
Albuquerque, NM 87185
(505) 844-3601 or 2377

Ames Laboratory**Multisector Energy Conversion and Utilization Technology and Materials****Description**

At this facility advanced industrial materials are developed to help reduce the energy demand on industry. The goal of one typical project is to prepare corrosion-resistant and high-temperature materials using a powder metallurgy process. The goal of another is to decrease the losses and increase the efficiency of electro-mechanical coupling in highly magnetostrictive materials. The program uses minority Iowa State University graduate students interested in advanced industrial materials to conduct a major part of the research.

User Arrangements

Contact the Office for Planning and Technology Application to make arrangements (see page 4).

Contact

Daniel E. Williams
Office for Planning and
Technology Application
Ames Laboratory
Ames, IA 50011
(515) 294-2635

Argonne National Laboratory**3-D Microfocus X-Ray-Computed Tomography Laboratory****Description**

This facility is used to nondestructively characterize ceramic materials as part of process development and to examine ceramic components for uniformity in density and dimensions for automotive parts.

The facility houses several special pieces of equipment that together make up a total system. The X-ray source is a 160-kV_p water-cooled anode, microfocus source. The X-ray detector consists of a special image intensifier connected to a very high resolution (1024 × 1024 × 14 bit) capacitively-coupled device (CCD) array camera controlled by a host 386/33 MHz IBM personal computer that also controls a part-manipulation table. Software packages include one for data acquisition and machine control and one for image reconstruction, which is done on a network-accessible SUN SPARC 2/GS workstation.

User Arrangements

Contact the laboratory manager. Because many technical details are involved in using this laboratory, users must work in cooperation with Argonne staff.

Laboratory Manager

William A. Ellingson
Materials and Components
Technology Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-5068
FAX (708) 252-4798

Argonne National Laboratory**Infrared Imaging Laboratory****Description**

This facility is used to nondestructively study the thermal behavior of various materials. Primary applications to date have been to detect nonbonds in graded-layer ceramic coatings and fiber/matrix interfaces in continuous fiber ceramic matrix composites. One use for these composites is for engine pistons.

Equipment includes an Infracometrics 600 infrared camera and a 3-12-μm lens coupled to a MAC II-fx computer with an 8-bit frame grabber. This instrument is on a local area network, allowing use of a SUN workstation for data analysis. All data-acquisition equipment are mounted on a stainless steel, 1.2 × 2.4 × 0.3 m (4 × 8 × 1 ft) vibration-isolated table. A special, locally written software code allows time-dependent analysis of full-frame images or partial images.

User Arrangements

Contact the laboratory manager. Because many technical details are involved in using this laboratory, users must work in cooperation with Argonne staff.

Laboratory Manager

William A. Ellingson
Materials and Components
Technology Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-5068
FAX (708) 252-4798

Argonne National Laboratory

Laser Scattering Laboratory

Description

This facility is used to nondestructively characterize surfaces of materials using noncontact laser scattering.

The facility houses a 35- μm helium-neon laser and a full array of optical components, including Fourier lenses. A $512 \times 512 \times 8$ bit CCD camera controlled by a 486/33-MHz IBM microcomputer on a $1.2 \times 2.4 \times 0.3\text{-m}$ ($4 \times 8 \times 1\text{-ft}$) vibration-isolated optical bench is used for mounting optical components. This is all mounted on a precision-surface granite table. Data files can be transferred via a local area network to a SUN workstation for more extensive analysis. Researchers can use special software packages to establish relationships between scattering data and surface characteristics. Argonne staff members are working on a software package that may allow researchers to predict laser-scatter behavior as a function of surface characteristics.

User Arrangements

Contact the laboratory manager. Because many technical details are involved in using this laboratory, users must work in cooperation with Argonne staff.

Laboratory Manager

William A. Ellingson
Materials and Components
Technology Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-5068
FAX (708) 252-4798

Argonne National Laboratory

Nuclear Magnetic Resonance Imaging Facility

Description

This facility is used to nondestructively characterize the chemical and physical properties of solid-state materials, including ceramics (monolithics and composites), polymers, (rigid and toughened polymer systems), catalysts, and coal.

The facility houses a custom-built 2.3-tesla imaging system. A second 9.4-tesla imaging system is currently under construction. Both systems provide versatility in experimental setup, variable temperature capabilities, high-power radio frequencies, and a high-power magnetic field gradient. Additional equipment includes several unique image-reconstruction computer programs and image-processing work stations.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

S.L. Dieckman
Materials and Components
Technology Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-5628

Argonne National Laboratory

Surface Engineering Laboratory

Description

This facility is used to prepare surface-modified materials for applications in advanced heat engines.

Equipment includes an ion-beam-assisted deposition system capable of depositing a variety of lubricious metallic and wear-resistant ceramic coatings on both metal and ceramic substrates, including engine pistons, cylinder wall inserts, and fuel injector plungers. Additional equipment includes a plasma-sputtering system to form multilayer lubricious oxide and metallic films on a variety of substrates and a microwave-plasma system used for diamond and diamond-like carbon films and cubic boron nitride.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Fred A. Nichols
Materials and Components
Technology Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-8292

Argonne National Laboratory**Tribology Laboratory****Description**

This facility is used to evaluate friction and wear on advanced and surface-modified materials for high-temperature transportation applications.

The facility houses three pin-on-disk machines with dry and lubricated testing capabilities. One machine can test up to 500°C at speeds up to 8 m/s and loads up to 150 N. Other equipment includes a high-temperature oscillating-slider test machine, a surface-texture-measuring device, and a scanning electron microscope with a microindentation-hardness measuring device attached.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Fred A. Nichols
Materials and Components
Technology Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-8292

Brookhaven National Laboratory**Advanced Materials Development Laboratory****Description**

This facility specializes in the synthesis and characterization of polymer, elastomer, ceramic, and cementitious matrix composites for use in severe environments such as geothermal wells.

Special high-temperature and -pressure equipment includes a consistometer, a permeameter, and autoclaves. Analytical equipment includes a scanning electron microscope, an X-ray spectrometer, a transmission electron microscope, an X-ray photoelectron spectrometer, X-ray diffraction equipment, a Fourier-transform infrared spectrometer, a differential scanning calorimeter, thermogravimetric analysis equipment, a thermal-mechanical analyzer, an Auger electron spectrometer, and mechanical testing equipment.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Lawrence E. Kukacka
Department of Applied Science
Brookhaven National Laboratory
Upton, NY 11973
(516) 282-3065

Brookhaven National Laboratory**Superconducting Materials Characterization Laboratory****Description**

This facility is used to characterize the microstructure and electro-magnetic properties of superconductors.

Special equipment includes a transmission electron microscope equipped with an energy-dispersive X-ray spectrometer and a parallel electron energy-loss spectrometer, a high-resolution scanning electron microscope, a scanning Auger multiprobe spectrometer, a SQUID magnetometer, an apparatus to characterize the strain dependence of critical current densities as a function of applied magnetic field, and a scanning tunneling microscope capable of operation at cryogenic temperatures.

User Arrangements

Contact the laboratory managers.

Laboratory Managers

Masaki Suenaga or David Welch
Department of Applied Science
Brookhaven National Laboratory
Upton, NY 11973
(516) 282-3518 or 3517

Idaho National Engineering Laboratory

Intelligent Sensing and Control Laboratory

Description

This facility is used to develop intelligent sensing and control technologies for manufacturing and materials processing. Capabilities include unique, artificial intelligence tools; classical, advanced, and intelligent controllers; and conventional and intelligent sensors.

The facility includes manufacturing and materials processes for welding, surfacing, joining, cutting, and metal spraying operations with an emphasis on near-net-shape fabrication. A robotic work cell and a variety of sensor hardware, computers, and software development tools are also available.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Herschel B. Smartt
Materials Processing Unit
Idaho National Engineering Laboratory
Idaho Falls, ID 83415
(208) 526-8333

Idaho National Engineering Laboratory

Nonintrusive Nondestructive Materials Characterization Laboratory

Description

This facility is used to research, develop, and apply noncontacting nondestructive materials characterization methods to process control and material characterization issues.

The facility houses laser and acoustic methods to create and receive sonic and ultrasonic waves that do not contact the material. The interaction of these waves with the material is then analyzed to determine material properties while the material is in service or being processed. The materials can be in a high-temperature or high-pressure environment that precludes the use of standards sensors.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

James A. Seydel
Nondestructive Materials Characterization Unit
Idaho National Engineering Laboratory
Idaho Falls, ID 83415
(208) 526-6000

Idaho National Engineering Laboratory

Rapid Solidification Processing and Testing of Metallic Alloys Laboratory

Description

This facility is used to produce metallic alloys with superior high-temperature properties using a rapid solidification process.

The facility houses a laboratory-scale gas atomizer that produces 4–5 kg of rapidly solidified metallic powders. A particular emphasis is on iron-, nickel- and copper-based alloys. An in-house hot isostatic press consolidates the powders into suitable monolithic forms.

Extensive characterization capabilities for the powders and consolidated powders are available. Capabilities include analytical microscopy and mechanical property testing for hardness, tensile, creep, fatigue, and fracture toughness.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Robert M. Neilson, Jr.
Metals and Ceramics
Idaho National Engineering Laboratory
Idaho Falls, ID 83415
(208) 526-8274

Idaho National Engineering Laboratory**Spray Forming Facilities****Description**

These facilities are used to develop and test a new materials processing technology called spray forming. The technique involves atomizing liquid metal into a controlled spray of uniform fine droplets with subsequent deposition into a mold or onto a substrate, which then rapidly solidifies. The process yields a near-net-shape product that requires little machining, forging, or rolling. The process is suitable for monolithic solids and coatings, metals and nonmetals, and composites.

The spray-forming facilities include a 557-m² (6000-ft²) laboratory and three independent spray systems with furnaces up to a capacity of 91 kg (200 lb), advanced particle diagnostics, and multidimensional modeling support process development.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

J.F. Key
Center for Materials Processing
Idaho National Engineering
Laboratory
Idaho Falls, ID 83415
(208) 525-5397

Los Alamos National Laboratory**Chemical Vapor Deposition and Infiltration Laboratory****Description**

This facility is used to research, characterize, and develop processes for coatings and reinforced composites. Its capabilities include microwave-assisted chemical vapor infiltration (CVI), thermal-assisted chemical vapor deposition, plasma-assisted chemical vapor deposition, organometallic chemical vapor deposition, and diamond film synthesis.

CVI can be used to infiltrate MoSi₂, W, Mo, Ta, TaC, SiC, B₄C, Al₂O₃, TiB₂, NbC, Nb, Zr, and ZrC into C, SiC, Mo, W, B, and Ti reinforcements. Bulk coatings include W, Mo, Ni, Nb, Zr, B₄C, BN, Al₂O₃, TiB₂, Ta, TaC, SiC, NbC, ZrC, carbon, and diamond. Modeling capabilities range from the atomic level to unit operations.

The facility includes several types of reactors: thermal hot wall, cold wall, fluidized bed, radio-frequency (RF), microwave, plasma, DC glow discharge, and hollow cathode. Numerous microwave and RF sources are available. Analytical equipment includes X-ray diffraction equipment, an X-ray fluorescence spectrometer, a scanning electron microscope, a transmission electron microscope, a Fourier transform infrared spectrometer, an Auger electron microprobe, a Rutherford backscattering spectrometer, a differential scanning calorimeter, and a nuclear magnetic resonance spectrometer.

(continued)**User Arrangements**

Contact the laboratory manager.

Laboratory Manager

Joseph R. Laia
Materials Science and
Technology Division
Los Alamos National Laboratory
Los Alamos, NM 87545
(505)-667-6887

Los Alamos National Laboratory

**Intermetallic Materials
Fabrication Laboratory**

Description

This facility is used to develop advanced intermetallic materials such as silicides and beryllides. Facility equipment is available for powder preparation and characterization, sintering, hot pressing, hot isostatic pressing, plasma spraying, single-wire arc plasma spraying, two-wire arc spraying, powder flame spraying, and centrifugal atomizing. The facility can melt high-temperature structural materials through processes such as melt spinning.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Anthony D. Rollett
Materials Science and
Technology Division
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 667-4368

Los Alamos National Laboratory

**Microwave Processing
Laboratory**

Description

This facility is used to research and develop microwave processing techniques for ceramic materials, including filament processing, bulk sintering, powder synthesis, ceramic joining, and particle processing. The facility is also used to test and develop organic waste remediation through microwave processing in a fluidized-bed reactor.

The facility includes two 2.45-GHz microwave systems, operating at 3 kW and 6 kW, for filament and bulk studies; an atmosphere control station for sintering studies; 35- and 84-GHz gyrotrons, operating at 30 kW; a 0.915-GHz microwave system, operating at 30 kW, for powder synthesis and waste remediation studies; a mass spectrometer for remediation emissions analysis; and a powder and materials characterization laboratory with such capabilities as sizing, imaging, thermal analysis, and X-ray diffraction analysis.

User Arrangements

Contact the laboratory managers.

Laboratory Managers

Joel D. Katz or Gerald J. Vogt
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 667-1134

Los Alamos National Laboratory

**Superconductivity
Technology Center: Powder
Synthesis Laboratory**

Description

This facility enables users to produce large quantities of superconducting powders used in fabricating bulk conductors. The facility supports work on superconductors to be used for electrical power generation.

User Arrangements

Contact Dean Peterson at
(505) 665-3030. Collaborative work
is available free of charge.

Laboratory Manager

Kenneth V. Salazar
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 665-3386

National Institute of Standards and Technology

Neutron Depth Profiling Facility

Description

This facility uses a neutron beam for the nondestructive evaluation of elemental depth distributions in materials. Working with the institute's 20-MW nuclear reactor, researchers use the technique to provide concentration profiles for characterizing the near-surface regime of semiconductors, metals, glasses, and polymers of depths of several micrometers. The facility uses filters and collimators to produce a high-quality neutron beam with good thermal neutron intensity and minimum contamination with fast neutrons and gamma rays. An aluminum target chamber is used to contain the samples in a vacuum, and a full array of electronic components is available for data acquisition and analysis.

Applications of neutron depth profiling include range measurements for boron implanted in silicon, gallium arsenic, and mercury-cadmium-telluride; observations on near-surface boron in glasses; lithium concentration profiles in lithium niobates and aluminum alloys; and measurement of helium release in single-crystal nickel to investigate the helium-trapping phenomena.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

James DeVoe
National Institute of Standards
and Technology
Gaithersburg, MD 20899
(301) 975-3144

National Renewable Energy Laboratory

α -Si:H Deposition and Characterization Laboratories

Description

These facilities provide specialized characterization capabilities for analyzing thin-film electronic materials, particularly amorphous silicon films applied to solar cells. Researchers use a "hot-wire" technique for the deposition of amorphous silicon materials.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Richard Crandall
Materials Sciences Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1913

National Renewable Energy Laboratory

Crystal Growth and Characterization Laboratories

Description

These facilities are used to grow and characterize semiconductor crystals at high temperatures (>1400°C) and pressures. Methods include directional solidifications, Czochralski growth, high-temperature solution growth, and other liquid growth methods. The operations are experimental in nature and hence undergo changes in configuration at various times.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Ted Ciszek
Materials Sciences Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1769

National Renewable Energy Laboratory

High-Flux Solar Furnace*

Description

This facility is used to modify surfaces of various materials. The furnace consists of a heliostat, two advanced concentrators, an attenuator, a shutter, a positioning table, a turning mirror, and a data acquisition and control system.

The furnace provides photons over a full range of the solar spectrum at intensities up to 3000 W/cm^2 (39,000 suns) at power levels to 10 kW. Photon processing allows surface modifications and high heating rates not possible with conventional furnaces. A long focal length and off-axis design allow the flexibility of having the experimental setup in a separate building and using of unique secondary concentrators. Both vertical and horizontal target orientations are available.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Allan Lewandowski
Thermal Systems Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1972

National Renewable Energy Laboratory

Low-Energy Ion-Beam Implantation Laboratory

Description

This facility is primarily used to analyze hydrogen passivation of defects in crystalline and amorphous silicon solar cells for photovoltaic applications.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Ted Ciszek
Materials Sciences Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1769

National Renewable Energy Laboratory

Materials Laboratory

Description

This facility is used to produce a variety of coatings up to 152 mm (6 in.) in diameter at temperatures ranging from below room temperature to 350°C . The coatings are produced using assorted gas-phase reactants. Researchers have produced electrochromic metal oxide films at rates as high as 40 nm/s and diamond-like carbon films at rates as high as 1 nm/s. In addition, semiconductor superlattice structures can be fabricated for photoelectron chemical applications.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Michael Seibert
Photoconversion Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1879

*The furnace was just designated a national user facility on July 16, 1993.

National Renewable Energy Laboratory**Materials Science Analysis Laboratories****Description**

These laboratories are used to analyze and characterize electronic and photovoltaic materials. The primary focus is to analyze the long-term efficiencies of materials and their compatibility with the environment. Specifically, studies include enthalpy; specific heat, melting, and freezing points; solid-solid transition; thermal expansion; weight loss and gain; tensile test; and flexure.

Other work includes X-ray topography, which is a method of analysis for dislocation configurations, stress, precipitates, decorated aggregate point of defects, and mechanical damage in crystalline materials.

The facility is also used to measure the photoluminescence, Raman scattering, and reflectance of electronic materials.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Managers

Ted Ciszek or
Angelo Mascarenhas
Materials Sciences Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1769 or 1368

National Renewable Energy Laboratory**Metalorganic Chemical Vapor Deposition Laboratories****Description**

The purpose of these facilities is to grow epitaxial semiconductor films on single-crystal semiconductor wafers using metalorganic chemical vapor deposition for photovoltaic applications.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Jerry Olson
Materials Sciences Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1121

National Renewable Energy Laboratory**Mirror Preparation and Exposure Testing Laboratories****Description**

These facilities house three types of accelerated weathering units used to test the reflector optical properties of reflector materials, including polymer samples and mirrors. Each unit can control ultraviolet light, heat, and humidity.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Gary Jorgensen
Thermal Systems Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-7273

National Renewable Energy Laboratory

Surface and Interface Analysis Laboratories

Description

This facility is used to characterize electronic materials using state-of-the-art surface analysis systems, including Auger electron spectroscopy, X-ray photoelectron spectroscopy, ultraviolet photoelectron spectroscopy, electron energy loss spectroscopy, and ion-scattering spectroscopy. The analyses provide accurate structural, chemical, and compositional information for semiconductor, metal, and insulator surfaces and interfaces.

The surface laboratories provide qualitative and quantitative analyses and maintain standards for accurate quantification of many semiconductor systems. The laboratories include special facilities for the *in situ* growth of layers in the analysis chambers. The laboratory has special arrangements for synchrotron radiation photoemission studies using the national facilities at the University of Wisconsin.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Managers

Art Nelson or Sally Asher
Measurements and
Characterization Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-7128 or 1015

Oak Ridge National Laboratory

Materials Processing Facility

Description

This facility is used to research melting, casting, and processing of experimental quantities (200–500 g) of advanced materials, which include intermetallics, iridium, and high-temperature superconductor oxide material.

Major equipment includes three nonconsumable drop furnaces that can melt up to 500 g of alloy and a vacuum-arc-remelting furnace that can accommodate 63.5–2030-mm-diameter (2.5–8-in.-diameter) ingots. Other furnaces include a 150-kW electron-beam-melting furnace, 1- and 45-kg (25- and 100-lb) air-induction melting furnaces, and a 9-kg (20-lb) vacuum-induction melting furnace.

There is a special 1134-metric-ton (1250-ton) extrusion press and billet heating to 2000°C. Billets may vary from 76 to 138 mm (3 to 5.5 in.) in diameter. Other equipment includes 136- and 453-metric-ton (150- and 500-ton) forging presses, four rolling mills, several swaging machines, three draw benches, a vacuum-annealing furnace, and a hydrogen-annealing furnace.

User Arrangements

Contact the laboratory manager to negotiate a work-for-others agreement or a cooperative research and development agreement.

Laboratory Manager

Vinod K. Sikka
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-5112
FAX (615) 574-7721

Oak Ridge National Laboratory

Material Thermal Analysis Facility

Description

This facility is used to measure the thermal conductivity of various insulation materials. Equipment includes an unguarded, thin heater apparatus that measures the thermal conductivity of specimens up to 100 × 150 × 20 cm (3 × 5 × 0.5 ft) from 20° to 50°C (68° to 122°F) when operated in a steady-state mode. Pulsing the power to the heater allows users to measure the thermal diffusivity of materials.

A heat-flow meter apparatus measures the thermal conductivity of specimens up to 60 × 60 × 20 cm (2 × 2 × 0.5 ft) from about 0° to 50°C (32° to 122°F). Researchers have measured specimens as small as 10-cm (4-in.) square and 1.3-cm (0.5-in.) thick.

Users can fabricate evacuated panel insulation specimens up to 60 × 60 cm (2 × 2 ft) and 2.5–5-cm (1–2-in.) thick. Vacuums of 0.5-mm (0.02 in.) mercury pressure can be obtained in heat-scalable plastic barrier materials. Users can measure the air-flow permeability of loose-fill insulations at room temperature.

User Arrangements

Contact the laboratory manager to negotiate guest assignments, work-for-others agreements, or cooperative research and development agreements.

Laboratory Manager

Tom Kollie
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-0712

Oak Ridge National Laboratory**Microwave Processing Laboratory****Description**

The facility is used to develop microwave processes and equipment for ceramic applications such as binder burnout, nitridation, sintering, and annealing.

Microwave furnaces include three 2.45-GHz/700-W ovens with a capacity of $< 0.08 \text{ m}^3$ ($< 3 \text{ ft}^3$); two 500-L atmospheric pressure furnaces that operate at 2.45 GHz/6 kW and /12 kW; one 100-L vacuum furnace that operates at 2.45 GHz/6 kW; one 5000-L bifrequency furnace that operates at 2.45 GHz/48 kW plus 28 GHz/15 kW; and one variable frequency furnace that is being upgraded to operate at 4–16 GHz.

User Arrangements

Contact the laboratory manager to negotiate a work-for-others agreement or a cooperative research and development agreement.

Laboratory Manager

Arvid E. Pasto
Ceramic Science and Technology
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-4956
FAX (615) 574-7721

Pacific Northwest Laboratory**Process Science and Engineering Complex: Materials Processing Laboratory****Description**

This facility is used for process scale-up and engineering development. Current operations include the Hydrothermal Processing and Superplastic Forming pilot plants. The former is used to study waste treatment, materials synthesis, separations, and supercritical fluids. The latter is used to test and evaluate new alloys, thermomechanical processing methods, modeling predictions, optimized variable strain path processes, and other associated manufacturing technologies leading to economical rapid superplastic forming.

This 620-m² (6650-ft²) high-bay and office facility houses an 18,140-kg (20-ton) overhead crane and several materials processing and engineering scale-up activities. Additional equipment includes a bench-scale rapid thermal decomposition system used to manufacture ultrafine powders. This system operates at a flow rate of 100 mL/min with conversions at 350°C and 550 atm.

The Hydrothermal Processing pilot plant has 10 different stainless-steel tubular and stirred tank reactors ranging in size from 1 to 75 L to recover acids and to concentrate the hazardous metals contained in steams in various applications and process configurations. The system can be operated in a batch or continuous mode at about 350°C and 75–375 atm. Additional equipment includes

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several high-pressure pumps, two continuous centrifuges, and a tower spray dryer.

The Superplastic Forming Pilot System includes a 75 × 75-cm hot press with computer-controlled gas system, tooling for experimental evaluation of new materials and processing methods, and associated instrumentation and inspection equipment. A design and analysis workstation provides a three-dimensional nonlinear analysis capability for forming simulation and generation of superplastic forming processing parameters.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Rod Quinn
Materials and Chemical
Sciences Center
Pacific Northwest Laboratory
Richland, WA 99352
(509) 375-6625

Sandia National Laboratories

**Center for Computer-Aided
Molecular Design**

Description

This facility studies materials and molecules using molecular modeling and computer-aided molecular design. Work broadly focuses in areas of energy conversion and materials design (catalysts, membranes, and advanced materials). One microVAX and two Silicon Graphics workstations, and modeling software (Insight, Discover, DMol, Biograf, and Polygraf) support this work.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Gary Carlson
Fuel Sciences Department
Sandia National Laboratories
Albuquerque, NM 87185
(505) 844-8116

Brookhaven National Laboratory

Energy Systems/ Environment/Economic Analysis Facility

Description

This facility develops and supports computer models and databases to perform comprehensive analyses of energy systems. These energy analyses can include consideration of energy resources and supply-side, end-use, and conservation technologies.

The primary models for this work are the Market Allocations (MARKAL) Model and the MARKAL-MACRO Model. These account for environmental and economic implications of energy system changes. Training and documentation for the MARKAL model is available.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Samuel C. Morris
Department of Applied Science
Brookhaven National Laboratory
Upton, NY 11973
(516) 282-2018

Brookhaven National Laboratory

National Photovoltaic Environmental, Health, and Safety Information Center

Description

This national center performs analyses to support the production and use of photovoltaics. These analyses include site audits, toxicology reviews, safety analyses, accident investigations, and permit analyses.

To expedite these analyses, the center develops and supports analytical computer models and databases. The center also maintains a computer bulletin board service.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Paul D. Moskowitz
Department of Applied Science
Brookhaven National Laboratory
Upton, NY 11973
(516) 282-2017

Lawrence Livermore National Laboratory

National Energy Research Supercomputer Center

Description

The center provides high-performance computing and networking services for researchers involved in energy-related work. Research areas include magnetic fusion energy, high energy and nuclear physics, basic energy sciences, health and environmental research, and the superconducting super collider.

User Arrangements

Contact Tom Kitchens, Office of Energy Research, U.S. Department of Energy, at (301) 903-5800.

Laboratory Manager

C. William McCurdy
Lawrence Livermore National
Laboratory
Livermore, CA 94551
(510) 422-6383

Los Alamos National Laboratory

Computational Testbed for Industry/High-Performance Computing and Training Center

Description

This center provides access to a powerful computing environment. The center serves as an interface between U.S. industry and the Los Alamos computing environment, facilitates computing collaborations, trains users in high-performance computing, offers workshops, and sponsors interns to study high-performance computing.

User Arrangements

Contact the facility director for information on the three costed membership categories.

Facility Director

Bruce Wienke
Computational Testbed for Industry
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 667-1358
FAX (505) 665-7176

Los Alamos National Laboratory

The Integrated Computing Network

Description

This network facility is used for production and experimental computing to support research in energy, the environment, engineering, and the basic sciences.

The communications network provides voice, data, and video communications. The experimental environment includes several massively parallel computers and advanced graphics workstations for scientific visualization. Users can access the supercomputers from individual workstations and through local area networks.

User Arrangements

Contact the program manager for information on how to access the facility and arrange collaborative agreements.

Program Manager

Nicholas Nagy
Computing and Communications Division
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 667-6164

National Renewable Energy Laboratory**Electro-optical
Characterization
Laboratories****Description**

These facilities are used for the characterization of electronic materials and devices, especially semiconductors, for electrical and optical properties.

Techniques include: unique minority-carrier characterization measurements for lifetime and diffusion parameters, time-resolved and conventional photoluminescence, deep-level transient spectroscopy, transient laser spectroscopy characterization (picosecond range) using time-of-flight and radio-frequency absorption detection, spectral ellipsometry, and complete current-voltage and capacitance-voltage spectroscopies. Special laboratory expertise is provided to link fundamental measurements and parameters with electronic device operation, including solar cells.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Richard Ahrenkiel
Measurements and
Characterization Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1770

National Renewable Energy Laboratory**Optical Characterization
Facilities****Description**

These facilities are used to measure and characterize optical materials.

This includes measuring the specular reflectance and transmittance of optical materials, characterizing their optical specularity, and characterizing the optical surfaces of point-focus concentrators.

One of the facilities houses a portable unit that can characterize the optical performance of line-focus concentrators in the field and in the manufacturing process.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Managers

Cheryl Kennedy or Tim Wendelin
Thermal Systems Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1308 or 7645

Sandia National Laboratories**Optical Properties
Characterization Laboratory****Description**

This facility is used to characterize the properties of optical materials. Capabilities include spectral transmittance and reflectance (specular or hemispherical) from 250 to 22,000 nm. Measurements up to 2500 nm are traceable to the National Institute of Standards and Technology. Additional capabilities include solar-averaged reflectance, total normal emittance, thin-film analysis, ellipsometry, and optical modeling.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Thomas C. Bickel
Photovoltaic Technology
Resources Department
Sandia National Laboratories
Albuquerque, NM 87185
(505) 845-9301

Florida Solar Energy Center

Photovoltaic Systems Test Facility

Description

These facilities are used to test photovoltaic (PV) systems and components. Sun-tracking stations are used to test PV arrays. Each computer-controlled station can support 900 kg (2000 lb) of PV arrays up to 80 m² (866 ft²) in size and in a range of kilowatts-peak. The stations can be operated in single- or dual-axis tracking modes or at fixed orientations.

A computer-controlled facility simulates the performance of PV systems while measuring the characteristics of actual loads, batteries, and charge controllers. Components are stressed through thermal and humidity cycles in an environmental chamber. Other facilities are available to test modules and inverters.

The Stand-Alone PV Systems Test Facility is used to examine design and control strategies and components for PV systems. The facility uses two 1-kW_p arrays to provide power for batteries and loads not interconnected with the utility. Researchers are currently evaluating hydrogen/nickel-oxide batteries.

Researchers are also testing PV modules on utility-interactive residential buildings. Tests are on 65-m² (700-ft²) buildings using 3.7 kW_p of ribbon cells, 2.7 kW_p of crystalline cells, and a 3-4-kW_p thin-film array. Another test is on a 130-m² (1400-ft²) house equipped with a 5-kW_p array and utility-interactive power-conditioning components.

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A facility is also available to charge a battery bank for an electric vehicle under test to determine charging characteristics. The facility comprises three PV arrays that can provide from 350 W to 1.5 kW_p.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Jim Dunlop
Florida Solar Energy Center
Cape Canaveral, FL 32920-4099
(407) 783-0300 x140

Florida Solar Energy Center

Photovoltaic Thin-Film Laboratory

Description

The facility is used to research the manufacture of copper indium diselenide (CuInSe₂) and cadmium telluride (CdTe) photovoltaic cells using magnetron sputtering techniques.

Laboratory equipment includes a dual-chamber vacuum deposition system. Both chambers are equipped with high-vacuum pumps that provide a clean hydrocarbon-free ambient and that operate in a range of pressures.

The system has three 7.6-cm (3-in.)-diameter planar magnetron sputtering sources in the larger of the two chambers and two UHV-type 7.6-cm (3-in.) magnetron sputtering sources in the smaller, six-way chamber.

The system is equipped with a DC power supply and a radio frequency power supply with an air-cooled machining network. The larger chamber is fitted with electrodes and holders for vacuum evaporation using an independent power supply. A microcomputer and RD 232 interfaces provide process control and data acquisition.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Neelkanth Dhere
Florida Solar Energy Center
Cape Canaveral, FL 32920
(407) 783-0300 x207

National Renewable Energy Laboratory**Cadmium Telluride Solar Cell Research Laboratory****Description**

This facility is used to fabricate thin, cadmium sulfide (CdS) films, high-efficiency CdS/CdTe (cadmium telluride) thin-film solar cells, and large area coatings of CdS and CdTe. Researchers can characterize the optics and electrical defects of thin-film solar cell materials in the manufacture of photovoltaic materials. They also use the facility for close-spaced sublimation.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Kannan Ramanathan
PV Device Development Branch
National Renewable Energy Laboratory
Golden, CO 80401
(303) 231-1954

National Renewable Energy Laboratory**Diagnostic Device Processing Laboratories****Description**

These facilities are used for growing silicon crystals and preparing and sectioning silicon crystals into wafers.

Researchers primarily fabricate diagnostic silicon solar cells ranging in size from 2×2 -mm squares to circles 75 mm in diameter. The facility also cleans, etches, and performs phenol/neutral diffusion and metallization of silicon solar cells.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Ted Cizek
Materials Sciences Branch
National Renewable Energy Laboratory
Golden, CO 80401
(303) 231-1769

National Renewable Energy Laboratory**Epitaxial Materials Growth Laboratories****Description**

These facilities are used to grow a wide range of epitaxial III-V materials in a controlled environment. These materials are used to make high-efficiency solar cells.

Researchers use these facilities to develop complex photovoltaic device structures and other heterostructure devices.

Group III materials include indium (In), gallium (Ga), and aluminum (Al); Group V materials include arsenic (As) and phosphorus (P). Researchers also grow epitaxial germanium (Ge). They can also grow GaAs, InP, InAs, Ge, and Si (silicon) on substrates up to 5 cm (2 in.) in diameter.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Managers

Mark Wanlass or Peter Sheldon
PV Device Development Branch
National Renewable Energy Laboratory
Golden, CO 80401
(303) 231-7632 or 1789

National Renewable Energy Laboratory

Photovoltaic Module and Component Reliability Physics Laboratory

Description

This facility is used to design and perform thermal and photothermal experiments and accelerated tests on encapsulant materials, solar cells, and photovoltaic modules. This facility forms the DOE center for photovoltaic module encapsulation research. Researchers can analyze the degradation and failure mechanisms for materials under specific light and thermal conditions and design experiences for accelerated lifetime testing of components. The analysis includes chemical, compositional, electrical, and physical evaluations of the components.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Managers

Alvin Czanderna or
John Pern
Measurements and
Characterization Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1240 or 7635

National Renewable Energy Laboratory

Photovoltaic Module and Systems Performance and Engineering Test Facilities

Description

This facility is used to characterize and test the performance of photovoltaic cells and photovoltaic modules. Tests are conducted under simulated, accelerated, and prevailing outdoor conditions.

Standardized characterization tests are conducted under controlled laboratory conditions on photovoltaic cells, modules, and module-material encapsulation systems. Outdoor tests are conducted on modules and systems for performance and reliability. Researchers conduct photovoltaic technology validation and solar radiation research on instrumentation as well as calibrations based on international standards.

The facility houses solar cell and module simulators and a large-area environmental test chamber used for module qualification tests.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Richard DeBlasio
PV Engineering and
Applications Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1286

National Renewable Energy Laboratory

Photovoltaic Performance Characterization Facility

Description

This central national facility supports the worldwide photovoltaic (PV) community with accurate traceable characterization of PV cells and modules. Researchers provide accurate efficiencies of PV components and reference cell calibrations under standard measurement and reporting conditions. Facilities include spectral response and quantum efficiency characterization and light/dark current-voltage measurements. Simulators include constant light and pulsed light sources for component areas ranging from millimeter-square cells through meter-square modules.

The facility provides links to international standards activities for the characterization of photovoltaic cells and modules.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Keith Emery
Measurements and
Characterization Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1032

National Renewable Energy Laboratory**Solar Cell Device Process Laboratories****Description**

These facilities are used to process semiconductors and to characterize defects in all types of solar cells.

Researchers fabricate thin-film and single-crystal solar cells using photolithography. Researchers also do photolithographic processing of semiconductors (including photoresist application and mask alignment) and electrochemical plating of metals.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Managers

Craig Marshall or Tim Gessert
PV Device Development Branch
National Renewable Energy Laboratory
Golden, CO 80401
(303) 231-1762 or 1951

National Renewable Energy Laboratory**Thin-Film Development Laboratories****Description**

These facilities are used to manufacture solar cells; to prepare polycrystalline thin films; and to characterize photovoltaic devices, thin-film semiconductors, and insulators. Specific processes include measuring the dark/light and low-temperature (25–300 K) current-voltages of electronic devices (photodiodes, thin films), the total transmission and reflection of thin films, and the photoconductivity of solid-state materials and devices.

Researchers also use the facility to fabricate copper indium diselenide (CuInSe_2) cells using both hydrogen and nonhydrogen selenium sources. Additional processes include evaporation, sputtering, electro-deposition, chemical deposition, and spectroresponse measurements.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Rommel Noufi
PV Device Development Branch
National Renewable Energy Laboratory
Golden, CO 80401
(303) 231-7310

Pacific Northwest Laboratory**Power Beaming Laboratory****Description**

This facility is used to characterize and evaluate solar cells and to illuminate monochromatic cells.

The facility houses illumination equipment that can generate a 806-nm wavelength; a 10-W laser diode source; equipment with power densities up to 500 mW/cm² for a 4 × 4 cm area; a temperature-controlled stage with a cell temperature readout; illumination-beam characterization equipment; and computer-controlled experimental execution, data acquisition, and analysis equipment.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Norm Anheier
Applied Physics Center
Pacific Northwest Laboratory
Richland, WA 99352
(509) 375-2639

Sandia National Laboratories

**Photovoltaic Device
Fabrication Laboratory**

Description

This facility develops high-performance, low-cost, one-sun concentrator cells for use as semiconductor and photovoltaic cells. The facility allows for collaborative research with industry in the development of cell-processing techniques.

Installed equipment includes a diffusion furnace with liquid-source dopants, pyrogenic steam oxidation, and *in situ* trichloroethane cleaning. Analytical equipment permits optical and electrical characterization, which includes a microwave photoconductivity-decay lifetime-monitoring system.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Paul Basore
Photovoltaic Technology Research
Department
Sandia National Laboratories
Albuquerque, NM 87185
(505) 844-3761

Sandia National Laboratories

**Photovoltaic Device
Measurement Laboratory**

Description

This facility provides accurate performance measurements and product-development testing of photovoltaic cells for cell manufacturers.

Cell measurements, analyses, and calibrations are all traceable to the National Institute of Standards and Technology. The facility is equipped with one-sun and multisun simulators capable of light current-voltage tests, equipment that can take a laser-beam-induced current scanner, and equipment that can take optical and spectral response measurements.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Barry Hansen
Photovoltaic Technology
Evaluation Department
Sandia National Laboratories
Albuquerque, NM 87185
(505) 844-2727

Sandia National Laboratories

**Photovoltaic Systems
Engineering Laboratory**

Description

This facility tests the performance and reliability of photovoltaic systems and develops, jointly with industry, balance-of-systems hardware.

Equipment at this facility includes battery- and charge-controller test equipment; stand-alone photovoltaic systems; a power electronics laboratory; and water disinfection, water pumping, and vaccine refrigeration evaluation facilities.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Mike Thomas
Photovoltaic Systems Research
Department
Sandia National Laboratories
Albuquerque, NM 87185
(505) 844-3698

Sandia National Laboratories

**Photovoltaic Technology
Evaluation Laboratory**

Description

This facility provides accurate performance and reliability measurements and product development testing and evaluation of photovoltaic modules and cells.

The facility accommodates both one-sun and concentrator hardware. Reliability tests include accelerated ultraviolet aging, hail impact, water spray, environmental cycling, and electrical performance.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Joe Woodworth
Photovoltaic Technology
Evaluation Department
Sandia National Laboratories
Albuquerque, NM 87185
(505) 844-7247

Florida Solar Energy Center

Daylighting Availability Measurement Station

Description

This station, designated a world-class facility by the International Daylighting Committee, is used to measure solar radiation conversion.

The station houses a sky camera system that records all-sky photographs hourly and during each sky scan, two 1.2 × 1.2-m (4 × 4-ft) scale models to collect daylight illuminance measurements from the four compass directions, two shadowband sensors that measure solar and circumsolar radiation, a rotating sky scanner with nine luminance sensors that map sky luminance distribution, a twilight scale model with five photometric sensors to measure internal illumination from the whole sky, and a sky imager consisting of a 180-deg field-of-view CCD array camera, frame grabber, and digitizing recorder. All equipment, including data acquisition, is computer-controlled.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Ross McCluney
Florida Solar Energy Center
Cape Canaveral, FL 32920
(407) 783-0300 x134

National Renewable Energy Laboratory

Solar Radiation Research Laboratory

Description

This facility provides measurements of solar radiation and other meteorological data to support research in renewable energy. The facility is also used to calibrate broadband radiometers outdoors that are traceable to the World Radiometric Reference using a reference group of absolute-cavity radiometers. Outdoor spectral and broadband radiometer measurements are also used to evaluate photovoltaic device performance. In addition, researchers can use the facility to develop and test new instrumentation, such as automated solar trackers.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Tom Stoffel
Technology and Resource
Assessment Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1390

National Renewable Energy Laboratory

Solar Industrial Test Area**Description**

This outdoor facility is used for solar thermal and industrial experiments, and particularly for experiments related to solar detoxification of hazardous wastes in water and air. It is ideal for experiments that require a low to medium concentration (1-20 suns) of ambient sunlight.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Mark Mehos
Thermal Systems Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1258

Argonne National Laboratory

Superconductive Ceramic Processing and Applications Laboratory

Description

This facility is used to research ceramic superconductor materials and components, including powder synthesis reaction kinetics, and component fabrication and evaluation. Components include ceramic superconducting wire, electromagnets, and magnetic bearings.

Equipment includes 35 computer-controlled furnaces, many of which contain controlled atmospheres or a vacuum; a 30-kW induction furnace, hot and cold presses, two continuous extruders, spray dryers, a plasma spray booth, a scanning electron microscope with energy-dispersive X-ray analysis, an X-ray diffractometer equipped with a high-temperature stage, differential thermal analyzers, a large-bore cryostat with a 7-tesla magnet, and a 1000-amp pulse current source. The facility also houses a complete foundry with rolling mills, swaging equipment, and a drawing bench for ceramic-metal composite wiremaking.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Roger B. Poeppel
Materials and Components
Technology Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-5118

Los Alamos National Laboratory

Superconductivity Technology Center: Dynamic Impedance Measurements of Superconducting Wires Laboratory

Description

The facility is used to characterize long lengths of superconducting wires with respect to the transition temperature and critical current. The facility supports work on superconductors to be used for electrical power generation.

User Arrangements

Contact Dean Peterson at (505) 665-3030. Collaborative work is available free of charge.

Laboratory Manager

Joe A. Martin
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 667-4377

Los Alamos National Laboratory

Superconductivity Technology Center: High-Temperature Superconductors—Electrical Characterization Laboratory

Description

This cryogenic facility is used to measure critical currents, critical magnetic fields, critical temperatures, magnetic flux motion, and magnetization of superconductors generally from temperatures of about 2 K up to room temperature and in magnetic fields up to 8 tesla as appropriate.

User Arrangements

Contact Dean Peterson at (505) 665-3030. Collaborative work is available free of charge.

Laboratory Managers

J. Yates Coulter or
Martin P. Maley
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 665-4351 or 0189

Los Alamos National Laboratory**Superconductivity
Technology Center: National
High-Magnetic Field
Laboratory****Description**

This facility is used to measure critical magnetic fields of high-temperature superconductors, which require very high fields. This facility can also be used to perform mechanical testing and deformation studies.

User Arrangements

Contact Dean Peterson at (505) 665-3030. Collaborative work is available free of charge.

Laboratory Manager

Laurence J. Campbell
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 667-1482

Los Alamos National Laboratory**Superconductivity
Technology Center: Pulsed-
Laser Deposition Laboratory****Description**

Various excimer lasers and sample chambers permit preparation of thin films of high-temperature superconductors, buffer layers, and many other materials on different substrates.

User Arrangements

Contact Dean Peterson at (505) 665-3030. Collaborative work is available free of charge.

Laboratory Manager

Xindi Wu
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 665-2370

National Renewable Energy Laboratory**Superconductor
Laboratories****Description**

These facilities are used to make superconductors and measure their various features.

Researchers make superconductors by using electrodeposition, first depositing the chemicals onto a substrate and then heating the coated substrate.

Measurements include critical current versus temperature (4–300 K) and magnetic field (0–1 tesla; 0–5 tesla arriving mid-1993), resistance versus temperature (4–300 K), DC capability (0–100 amps), and AC magnetic susceptibility.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Richard Blaugher
PV Device Development Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-7298

Oak Ridge National Laboratory

**High-Temperature
Superconductivity Pilot
Center: Magnet Laboratory**

Description

This facility houses background magnets used to test critical properties of superconductors. Equipment consists of two large water-cooled copper solenoids powered by motor-generator sets. One solenoid has a 15.2-cm bore to 8 tesla. (A Dewar insert provides a 12.7-cm cold bore.) A second solenoid has a 27.9-cm bore with a magnetic field strength of up to 6 tesla. (A Dewar insert provides a 25.4-cm bore.) Another motor-generator set and a variable-temperature cryostat (4.2-300 K, 0-8 tesla, ramped field) is available for samples (16 kA).

Also available are two 25-kA, four 16-kA, and a 12-V power supplies; a 2-kA, 300-V pulse power supply; a 30-kA, 20-V DC power supply; two large Dewar flasks (91.4 cm and 76.2 cm in diameter); and vacuum pumps.

A superconductivity laboratory complementing the magnet laboratory is under construction.

User Arrangements

Contact Robert A. Hawsey at (615) 574-8057 to negotiate a cooperative research and development agreement, a work-for-others agreement, or other agreements.

Laboratory Manager

Martin S. Lubell
Fusion Energy Division
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-1451
FAX (615) 574-6073

Oak Ridge National Laboratory

**High-Temperature
Superconductivity Pilot
Center: Sample Physical
Properties**

Description

The facility is used to measure electrical transport, resistivity versus temperature and magnetic field, the Hall effect, and *in situ* orientation in superconductors. Samples must be less than 3-cm high. Currents up to 50-A pulsed are available.

A continuous-flow cryostat is used for low-current measurements of resistivity and critical temperature from 4.2 to 300 K. Researchers can measure DC magnetization in magnetic fields up to 7 or 8 tesla on samples shorter than 6 mm. Also, high-frequency AC critical-temperature measurements using radio-frequency inductive response can be made. Instruments also measure AC susceptibility in magnetic fields between 0 and 5 tesla DC or between 0 and 100 G AC, and at frequencies between 0 and 100 kHz.

User Arrangements

Contact the laboratory manager to negotiate a work-for-others agreement, a cooperative research and development agreement, or other agreements.

Laboratory Manager

Robert A. Hawsey
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-8057
(FAX) (615) 574-6073

Oak Ridge National Laboratory

**High-Temperature
Superconductivity Pilot
Center: Superconducting
Wire Measurements
Laboratory**

Description

This facility is used to make inductive and resistive measurements of superconducting transitions from 4.2 K to room temperature. In samples between 2- and 5-cm long, instruments can measure critical current density in magnetic fields ≤ 9 tesla, and at temperatures between 4.2 K and 300 K. Sample current is limited to about 40 A, although in rapid screening, currents to 100 A are available.

A Lakeshore Model 7225 AC susceptometer/DC magnetometer measures AC susceptibility and DC magnetization on samples less than 3 mm in diameter, in magnetic fields between 0 and 5 tesla, and at temperatures between 4.2 K and 300 K.

User Arrangements

Contact the laboratory manager to negotiate a work-for-others agreement, a cooperative research and development agreement, or other cooperative agreements.

Laboratory Manager

Robert A. Hawsey
Oak Ridge National Laboratory
Oak Ridge, TN 37831
(615) 574-8057
FAX (615) 574-6073

Sandia National Laboratories

Cryogenic Device Characterization Laboratory

Description

This facility develops and characterizes high-temperature superconductor materials used in wires and tapes. Transition temperatures and critical current densities can be measured in the temperature range of 4 K to 300 K in magnetic fields of up to 11 tesla.

User Arrangements

Although the facility is not available for outside use, you can contact the laboratory manager to have an individual sample tested.

Laboratory Manager

Pete Roth
Photovoltaic Technology Research
Department
Sandia National Laboratories
Albuquerque, NM 87185
(505) 844-3949

Argonne National Laboratory

Auto Shredder Residue Laboratory

Description

This facility is used to conduct experiments on recycling auto shredder residue. Researchers have developed a process to extract plastics from auto shredder residue after it is mechanically separated into three fractions.

Researchers are currently testing apparatus for separating fluff, extracting plastics, and regenerating the solvent. The extraction and regeneration apparatus is in a specially designed hood.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Bassam Jody
Energy Systems Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-4206

Argonne National Laboratory

Bioprocessing and Waste Treatment Laboratory

Description

These facilities are used to conduct bench-scale experiments on waste treatability, bioprocessing, and biochemistry. Experiments include producing useful chemicals from biomass and waste materials and evaluating waste treatment processes in a simulated landfill.

Equipment includes bench-scale fermenters, high-pressure liquid chromatographs, a mobile gas chromatograph/mass spectroscope, field sampling equipment, and an electrodialysis membrane.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Jim Frank
Energy Sciences Branch
Argonne National Laboratory
Argonne, IL 60439
(708) 252-7693

Argonne National Laboratory

Plastics/Organic Chemistry Laboratory

Description

This facility is used to chemically synthesize degradable polymers, mainly aliphatic polyesters such as poly (lactic acid), and prepare hydrogels in agricultural applications through the Tennessee Valley Authority and the National Fertilizer and Environmental Research Center. Researchers can also extract solvents from reclaimed thermoplastics, such as auto shredder residue, found in various waste streams.

Equipment includes laboratory-scale reactors up to 2-L in capacity, a solvent-extraction system that can handle 12 L, a 2.5 × 2.5-cm (6 × 6-in.) heated Carver platen press, and facilities for solvent casting of test films.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

P. Bonsignore
Energy Systems Division
Argonne National Laboratory
Argonne, IL 60439
(708) 252-4257

Los Alamos National Laboratory**Superconductivity
Technology Center:
Hazardous Materials
Preparation Laboratory****Description**

This HEPA-filtered facility is used to prepare thallium materials and can be used for almost any hazardous materials. Thallium is a prominent component of high-temperature superconducting materials.

This facility contains hoods, furnaces, and thermal analysis equipment useful in synthesizing materials.

User Arrangements

Contact Dean Peterson at (505) 665-3030. Available for collaborative work free of charge.

Laboratory Manager

Kenneth V. Salazar
Los Alamos National Laboratory
Los Alamos, NM 87545
(505) 665-3386

National Renewable Energy Laboratory**Plastics Recycling
Laboratory****Description**

This facility is used to study the conversion of mixed-waste plastics to high-value chemicals. Researchers convert the plastics using selective pyrolysis.

The facility houses small-scale fluidized-bed reactors coupled to on-line mass spectrometers. Larger batch and fluidized-bed reactors are used to test promising reactions on a larger scale. Research techniques include using analytical pyrolysis to rapidly characterize plastic samples including mixtures in waste streams.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Kuni Tatsumoto
Process Research Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-1938

National Renewable Energy Laboratory**Water Detoxification
Laboratory****Description**

This facility contains a solar-driven photocatalytic process that is used to look at the complete decomposition of hazardous organics and metals complexes contained in contaminated waters. Researchers can test real and simulated waste streams. Researchers can also determine ways of improving the photocatalysts used for this process.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Kimberly Magrini-Bair
Process Research Branch
National Renewable Energy
Laboratory
Golden, CO 80401
(303) 231-7056

Pacific Northwest Laboratory

**Process Science and Engineering Complex:
Mechanical Development Laboratory**

Description

This facility is used for the scale-up of advanced waste treatment, energy production, and separations research. Current projects include the Waste Acid Detoxification and Recovery System and the Thermochemical Environmental Energy System. The former is used to recover acids and to concentrate the hazardous metals contained in spent acid streams. The latter is used to recover energy in organics contained in wet waste streams as a medium-Btu fuel gas. Other systems are used to study gasification/pyrolysis of wood and other residues, tar cracking, catalytic reactions, reaction kinetics, and the use of supercritical fluids as alternatives to vapor degreasers to clean parts.

This 465-m² (5000-ft²) high-bay and engineering development facility houses a 9070-kg (10-ton) overhead crane and several bench-scale experimental systems. These systems include a fluidized-bed gasification system, a 600-cm³ Bertly reactor system rated at 400 atm at 400°C, and a fume hood.

The Waste Acid Detoxification and Recovery System is a 40 L/h modular pilot system constructed of acid-resistant fluoropolymer. The system uses a combination of vacuum distillation and selective precipitation to recover acids and to concentrate the hazardous metals contained in spent acid streams.

(continued)

The Thermochemical Environmental Energy System is a catalytic reforming and methanation process. A skid-mounted unit, the pilot system has all the unit operations, including heat recovery, of a conversion commercial plant. The unit can process up to 40 L/h of aqueous waste and is a 20-fold scale-up of the laboratory-scale unit housed in the Chemical Process Development Laboratory. Operating conditions for the two 15 × 7.5-cm catalytic reactors are 330°–350°C and 208 atm.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Rod Quinn
Materials and Chemical
Sciences Center
Pacific Northwest Laboratory
Richland, WA 99352
(509) 375-6625

National Renewable Energy Laboratory**National Wind Technology Center: Modal Test Facility****Description**

This facility provides two methods of structural excitation for modal tests of wind turbines—the hand-held hammer test and the ground-heated shaker test. With these tests, researchers determine the natural frequencies of components and systems and provide vital information required to reduce fatigue damage of rotating structures.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Richard Osgood
Systems Development Branch
National Renewable Energy Laboratory
Golden, CO 80401
(303) 231-7149

National Renewable Energy Laboratory**National Wind Technology Center: Structural Test Facility****Description**

This multiuse facility is used to test and evaluate the structural integrity of wind turbine blades. The nondestructive tests include photoelastic measurements, brittle lacquer, and deflection measurements. Researchers also conduct destructive blade tests to determine ultimate blade strength and to establish fatigue characteristics.

Equipment includes three test stands to support blades up to 18 m (60 ft) in length. The test stands and loading apparatus can withstand overturning torques up to 1.4 million N-m (1 million ft-lb). Researchers conduct fatigue tests using state-of-the-art servo-hydraulic simulation test equipment supplied by MTS Corporation.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

Walt Musial
Applied Research Branch
National Renewable Energy Laboratory
Golden, CO 80401
(303) 231-1456

National Renewable Energy Laboratory**National Wind Technology Center: Wind Turbine Test Facility****Description**

This facility is used to test wind turbine systems to determine their aerodynamic, structural, and electronic performance characteristics. Currently researchers are testing a 10-kW Bergey turbine and a 20-kW "combined experiment" turbine for unsteady aerodynamics. The facility is capable of testing other turbine designs.

User Arrangements

Contact NREL's Technology Transfer Office to make arrangements (see page 13).

Laboratory Manager

C. (Sandy) Butterfield
Applied Research Branch
National Renewable Energy Laboratory
Golden, CO 80401
(303) 231-1171

Sandia National Laboratories

**Vertical-Axis Wind Turbine
Test Bed**

Description

This facility tests and demonstrates advanced wind turbine concepts capable of generating utility-scale amounts of electricity from wind. Current tests include vertical-axis wind-turbine technologies. In addition, the facility provides variable-speed operation, advanced controls, and utility interfacing.

User Arrangements

Contact the laboratory manager.

Laboratory Manager

Henry M. Dodd
Wind Energy Technology
Department
Sandia National Laboratories
Albuquerque, NM 87185
(505) 844-5253 or 3910

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