PNNL-23689

Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by **Battelle** *Since 1965*

Federal High Performance and Sustainable Buildings

Guiding Principles for the Laboratory Support Building (LSB)

September 2014

J.E. Pope

U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract **DE-AC05-76RL01830**

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062;
ph: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service
5301 Shawnee Rd., Alexandria, VA 22312
ph: (800) 553-NTIS (6847)
email: orders@ntis.gov <http://www.ntis.gov/about/form.aspx>
Online ordering: http://www.ntis.gov

This document was printed on recycled paper.
(8/2010)

PNNL-23689

Federal High Performance and Sustainable Buildings

Guiding Principles for the Laboratory Support Building (LSB)

JE Pope

September 2014

Prepared for
the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory
Richland, Washington 99352

Pacific Northwest National Laboratory
Federal High Performance and Sustainable Buildings
Guiding Principles for the Laboratory Support Building (LSB)

Approvals

Prepared by: _____ 9/26/14
Jason Pope, HPSB Project Manager — Date

Approved by: _____ 9-26-14
Mike Moran, Sustainability Program Manager — Date

Approved by: _____ 9/26/14
Dave Brown, Chief Engineer — Date

Approved by: _____ 9/29/14
Sandra Fies, Building Manager — Date

Summary

This report provides a narrative of how Pacific Northwest National Laboratory's (PNNL) Laboratory Support Building (LSB) complies with each of the Federal Guiding Principle requirements for sustainable existing buildings within five areas: Employ Integrated Assessment, Operation, and Management Principles; Optimize Energy Performance; Protect and Conserve Water; Enhance Indoor Environmental Quality; and Reduce Environmental Impact of Materials. Specifically, PNNL is exceeding requirements in Executive Order (EO) 13423, "Strengthening Federal Environmental, Energy, and Transportation Management" and EO 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," which both require 15% of an agency's existing buildings and leases meet the Guiding Principles by 2015. Additionally, EO 13514 requires agencies to make annual progress toward 100% of buildings meeting the Guiding Principles. With exceeding the requirements, PNNL currently has about 25% of its buildings categorized as High Performance and Sustainable Buildings (HPSB). The pages that follow document the Guiding Principles conformance effort for LSB at PNNL. The effort is part of continued progress toward a campus building inventory that is 100% compliant with the Guiding Principles.

The included documentation is intended to provide a narrative of how the LSB complies with each of the Guiding Principles requirements. These narratives draw from the many sources that are explained in the text and rely on extensive data collection. The descriptions that follow point to each of these sources, providing the reader with specific policies, procedures, and data points.

Acronyms and Abbreviations

ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BAS	building automation system
BSS	Business Support Services
BTU	British thermal unit
CFC	chlorofluorocarbons
CFCT	Contracted Facilities Core Team
Cowperwood	Cowperwood Management Company, Inc.
CRI	Carpet and Rug Institute
DOE	U.S. Department of Energy
DSOM	Decision Support for Operations and Maintenance
EED	Energy and Environment Directorate, a PNNL research organization
EHS&S	Environmental, Health, Safety, and Security
EMS	Environmental Management System
EMSL	Environmental Molecular Science Laboratory
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPEAT	Electronic Product Environmental Assessment Tool
EPRP	Environmental Protection and Regulatory Programs Division
F&O	Facilities and Operations
FMCS	facility monitoring and control system
FSRIA	Farm Security and Rural Investment Act
FUA	Facility User Agreement
FY	fiscal year
g/L	grams per liter
GRI	Global Reporting Initiative
h/hr	hour(s)
HCFC	hydrochlorofluorocarbon
HPSB	high performance sustainable building
HVAC	heating, ventilation, and air-conditioning
IPM	integrated pest management
ISO	International Organization for Standardization
kW	kilowatt
LSB	Laboratory Support Building

MARS	Maintenance and Repair Forecasting application
MOU	Memorandum of Understanding
PM	periodic maintenance
PNNL	Pacific Northwest National Laboratory
PV	photovoltaic
RCRA	Resource Conservation and Recovery Act
SME	subject matter expert
SSP	Site Sustainability Plan
U.S.	United States
USDA	U.S. Department of Agriculture
VAV	variable air volume
VOC	volatile organic compound

Contents

Figures

Tables

1.0 Introduction

In 2006, the United States (U.S.) Department of Energy (DOE), along with 21 other agencies, signed the Federal Leadership in High Performance and Sustainable Buildings (HPSB) Memorandum of Understanding (MOU). Originally, the MOU committed DOE to follow Guiding Principles for new construction and major renovations and was revised in 2008 to include transforming existing buildings into HPSBs. The Guiding Principles for sustainable buildings focus on five topic areas:

1. Employ Integrated Assessment, Operation, and Management Principles
2. Optimize Energy Performance
3. Protect and Conserve Water
4. Enhance Indoor Environmental Quality
5. Reduce Environmental Impact of Materials.

Executive Order (EO) 13423, "Strengthening Federal Environmental, Energy, and Transportation Management" and EO 13514, "Federal Leadership in Environmental, Energy, and Economic Performance" both require that 15% of an agency's existing buildings and leases meet the Guiding Principles by 2015. Additionally, EO 13514 requires agencies to make annual progress toward 100% of buildings meeting the Guiding Principles.

Pacific Northwest National Laboratory (PNNL) is exceeding this requirement and currently, about 25% of its buildings are HPSB. The pages that follow document the Guiding Principles conformance effort for the Laboratory Support Building (LSB) at PNNL (Figure 1.1). The LSB effort is part of continued progress toward a campus building inventory that is 100% compliant with the Guiding Principles.

Figure 1.1. Outside View of LSB

The LSB is a 83,921 square foot building constructed in 1996 with 361 occupants and serves as a general office facility for various PNNL support service organizations. The LSB is leased to PNNL by the Cowperwood Management Company, Inc. (Cowperwood), which owns the LSB and two other buildings on the Richland campus.

The included documentation is intended to provide a narrative of how the LSB complies with each of the Guiding Principles requirements. These narratives draw from the many sources that are explained in the text and rely on extensive data collection. The descriptions that follow point to each of these sources, providing the reader with specific policies, procedures, and data points.

2.0 Guiding Principle Number One

2.1 Integrated Assessment, Operation, and Management

Guiding Principle One, Integrated Assessment, Operation, and Management, requires PNNL to use an integrated team to develop and implement policy regarding sustainable operations and maintenance. The integrated team at PNNL is detailed on the team roster in Figure 2.1 and works together to meet the five requirements discussed below.

High Performance and Sustainable Buildings Guiding Principles
Building Information and Project Team Page

Building Information	**Federal Real Property Building ID**	3350
	Building Name	Laboratory Support Building
	Agency/Site	DOE / PNNL
	PSO	PNSO
	Department	Office of Science
	Address	3350 George Washington Way
	City	Richland
	State	Washington
	Zip Code	99352

*Information entered above will auto-populate the appropriate fields on subsequent tabs

		Name	Phone	Email
Project Team	**Project Manager**	Jason Pope	(509) 375-7545	jason.pope@pnnl.gov
	Sustainability Program Manager	Mike Moran	(509) 375-2344	mike.moran@pnnl.gov
	Energy Program Manager	Larry Richards	(509) 371-7911	larry.richards@pnnl.gov
	Utility Manager	Marc Berman	(509) 371-7040	marc.berman@pnnl.gov
	F&O Chief Engineer	Dave Brown	(509) 371-7022	davidm.brown@pnnl.gov
	Building Manager	Sandra Fies	(509) 372-6737	sandra.fies@pnnl.gov
	Building Engineer	John Hickman	(509) 371-7031	john.hickman@pnnl.gov
	Sustainability Engineer	Shan Belew	(509) 371-7939	shan.belew@pnnl.gov
	Commissioning Engineer	Anthony Lechelt	(509) 371-6785	anthony.lechelt@pnnl.gov

Project Manager Signature:	Jason Pope	**Date:**	4/1/2014

Figure 2.1. PNNL Team Roster

2.1.1 Requirement 1

The first requirement is to "incorporate sustainable operations and maintenance practices within the appropriate Environmental Management System (EMS)." PNNL is committed to providing a safe and healthy working environment for all staff; protecting the general public and the environment from unacceptable environmental, safety, and health risks; and operating in a manner that protects and restores the environment.

Since 2002, PNNL has used an International Organization for Standardization (ISO) 14001-registered EMS (Figure 2.2) as a tool to help measure environmental performance through a rigorous process of goal-setting, planning, monitoring, and reporting. PNNL's sustainability goals development and implementation are spear-headed by an EMS core team that consists of representatives from key EMS programs. In 2009, a set of sustainability performance indicators aligned with the Global Reporting Initiative (GRI) sustainability reporting framework were incorporated into PNNL's EMS to improve further the overall sustainability performance management. Annually, sustainability effort results are captured in a Sustainability Report. Auditing conducted by independent third party has verified that the PNNL's Sustainability Program is fully integrated into the Laboratory's EMS and meets the requirements of EO 13514.


NSF International Strategic Registrations
789 North Dixboro Road, Ann Arbor, Michigan 48105
(888) NSF-9000 | www.nsf-isr.org

Certificate of Registration

This certifies that the Environmental Management System of

Battelle - Pacific Northwest Division

Pacific Northwest National Laboratory 902 Battelle Boulevard
Mail Stop J2-25
Richland, Washington, 99354, United States

has been assessed by NSF-ISR and found to be in conformance to the following standard(s):

ISO 14001:2004

Scope of Registration:
Pacific Northwest National Laboratory, operated by Battelle for the U.S. Department of Energy: Research and development activities and associated facilities operations

Certificate Number: 6Z781-EM5
Certificate Issue Date: 03-DEC-2012
Registration Date: 20-OCT-2011
Expiration Date *: 19-OCT-2014

William Niedzwiecki
President & General Manager,
NSF-ISR, Ltd.

Figure 2.2. Battelle – Pacific Northwest Division ISO 14001:2004 Registration

2.1.2 Requirement 2

The second requirement asks PNNL to "assess existing condition and operational procedures of the building and major building systems and identify areas for improvement." Part of the scope of the retro-commissioning project was to assess existing conditions in the LSB. This assessment included an evaluation of equipment and systems operations and conditions, interviews with facility operating and management staff, and discussions with vendors and third-party maintenance and construction personnel. As a result of the assessment, a list of operations and maintenance improvements and opportunities was developed. Details on opportunities and improvements that were implemented at the LSB as a result of the assessment are included in the commissioning section, below.

2.1.3 Requirement 3

Requirement 3 calls for PNNL to "establish operational performance goals for energy, water, material use and recycling, and indoor environmental quality, and ensure incorporation of these goals throughout the remaining lifecycle of the building." As required by DOE, the PNNL EMS core team develops an annual

Site Sustainability Plan (SSP). PNNL's progress toward the performance goal categories listed above is captured within the SSP.

Indoor environmental quality is detailed in the Facility User Agreement (FUA), an agreement that formally captures the physical attributes of the facility and operational boundaries, among other things. This agreement is between the Facilities and Operations (F&O) Directorate, the Environmental, Health, Safety, and Security (EHS&S) Directorate, and Business Support Services (BSS).

2.1.4 Requirement 4

This requirement asks PNNL to "incorporate a building management plan to ensure that operating decisions and tenant education are carried out with regard to integrated, sustainable building operations and maintenance." This requirement is fulfilled at a high level in the annual Laboratory Plan, where PNNL's commitment to sustainability is underscored as a key plan component. This emphasis by top PNNL management sets the tone for thousands of lower-level decisions made each year in support of integrated, sustainable building operations, and maintenance.

At a more detailed level, the Facility Management and Operations Program description details the specific key implementations and performance measures that encompass these daily decisions. Tenant education is carried out in multiple formats. The *Porcelain Press* (example shown in Figure 2.3), Sustainability website, the Sustainability Program's quarterly newsletter *Second Nature*, Sustainability Program YouTube videos, and the *PNNL Insider* newsletter all work to deliver important sustainability messages to staff members at PNNL.

Figure 2.3. Example of the *Porcelain Press* Newsletter

2.1.5 Requirement 5

The fifth requirement asks PNNL to "augment building operations and maintenance as needed using occupant feedback on work space satisfaction." PNNL meets this requirement by conducting a customer satisfaction survey for the building occupants. Staff members are asked to rate their satisfaction in the following areas:

- building interior
- building exterior
- immediate office and surroundings
- halls and lobbies
- restrooms
- laboratory and/or shop areas
- walls, ceilings, and floors
- elevators
- parking lots
- grounds
- facility temperature
- facility lighting
- walkways during inclement weather (snow/ice)
- grounds lighting
- safe parking lots
- workplace physical security
- workplace safety
- process for obtaining facility services (e.g., ESR)
- quality and timeliness of facility services
- Battelle Mail service (i.e., pick-up and delivery)
- walk-up copier locations
- walk-up copier reliability
- Central Duplicating Services
- conference room audio visual equipment
- conference room availability

Figure 2.4 shows survey results for each of the core teams in Building Maintenance, Walls, Ceilings/ Floors, and Restrooms category. The most recent survey of this building was conducted in 2011, and the previous survey was in 2008. The LSB is in the Contracted Facilities Core Team (CFCT). Supporting documentation detailing survey results in spreadsheet format can be made available upon request.

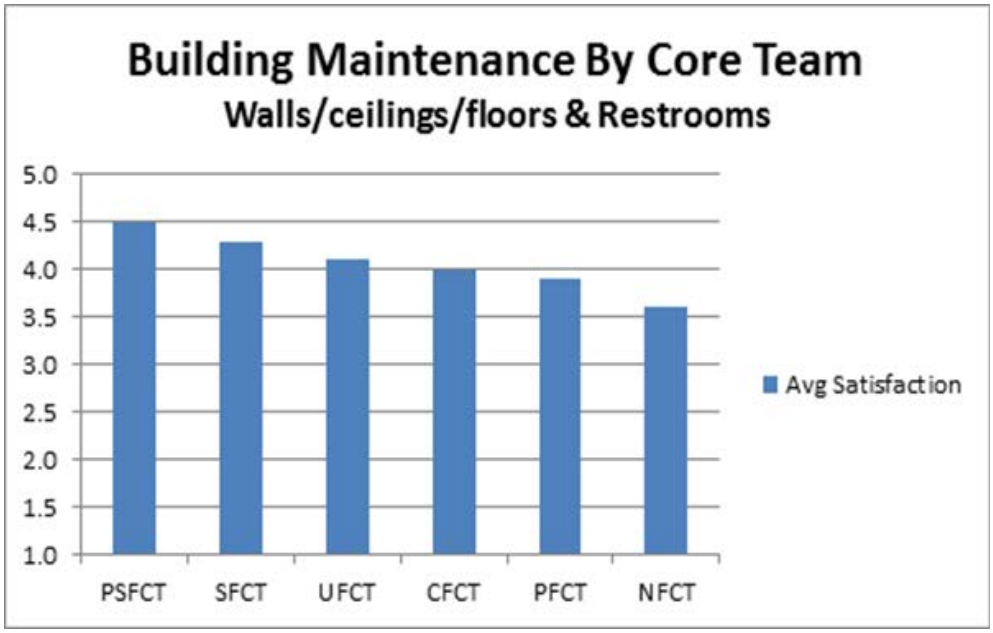

Figure 2.4. Building Maintenance by Core Team

2.2 Commissioning

This Guiding Principle requires that recomissioning tailored to the size and complexity of the building and its system components be performed within the last 4 years. In 2011, the LSB was recommissioned by Seattle, WA firm Engineering Economics Inc. In the final retrocomissioning report, energy conservation measures aimed at improving comfort, safety, and reliability as well as reducing energy consumption and emissions were recommended and implemented as described below.

1. Added a dedicated building automation system (BAS) outside air temperature sensor and input to sequence of operations to optimize control of heating, ventilation, and air-conditioning (HVAC) systems.
2. Added unoccupied start/stop for toilet exhaust fans.
3. Added optimal start and stop programming for units AC02E and AC-2W to reduce runtime based on seasonal needs.
4. Added night flush programming to BAS for AC-2E and AC-2W, using outside air to pre-cool the building based on outside air temp.
5. Added internet based control for full external BAS access.
6. Repaired all faulty variable air volume (VAV) boxes.
7. Installed new temperature and relative humidity sensors and changed economizer enable setpoint.
8. Relocated thermostat in deli area and changed temperature control setpoints.
9. Optimally reset duct static pressure setpoints for rooftop units.
10. Serviced and repaired cabinet unit heaters on first floor stairway entries.
11. Replaced circulation pump for domestic hot water heater DWH-1.
12. Replaced low voltage lighting control panel and reinstituted lighting schedule.
13. Added photosensors to control exterior fixtures.
14. Replaced mercury vapor fixtures on exterior lights with metal halide.

3.0 Guiding Principle Number Two

3.1 Energy Efficiency

The second Guiding Principle deals with optimizing energy performance. The energy efficiency requirement reads as follows:

> Energy Efficiency. Three options can be used to measure energy efficiency performance:
>
> - Option 1: Receive an ENERGY STAR® rating of 75 or higher or an equivalent Labs21 Benchmarking Tool score for laboratory buildings,
> - Option 2: Reduce measured building energy use by 20% compared to building energy use in 2003 or a year thereafter with quality energy use data, or
> - Option 3: Reduce energy use by 20% compared to the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 90.1-2007 baseline building design, if design information is available. Use ENERGY STAR® and FEMP-designated Energy-Efficient Products, where available.

PNNL opted to pursue Option 2 to meet this requirement. Using fiscal year (FY) 2005 as a baseline, total energy use was compared with FY 2013, the most recently completed year. No natural gas is used at the LSB, so only electricity was considered. Table 3.1 details consumption and highlights the 33.9% energy reduction from the baseline year.

Table 3.1. 2005 and 2013 Comparison of Energy Consumption

	Electricity in kilowatt hrs (kWh)	
Month	**FY 2005**	**FY 2013**
October	170,880	121,120
November	181,760	126,720
December	198,400	129,600
January	245,600	144,960
February	201,600	116,160
March	190,080	113,440
April	169,920	104,480
May	170,080	125,600
June	183,520	116,800
July	180,640	140,640
August	202,080	136,000
September	168,960	120,160
Total	**2,263,520**	**1,495,680**
% Reduction		**33.9%**

3.2 On-Site Renewable Energy

This Guiding Principle requires that on-site renewable energy projects be implemented on agency property for agency use when lifecycle cost-effective appropriate. To this end, PNNL has implemented a photovoltaic (PV) array that fulfills this requirement. The 125 kW PV array (Figure 3.1) produced 189.8 MWh of electricity in FY 2012, providing power to the Environmental Molecular Science Laboratory (EMSL), including a super-computing facility and adjacent car charging stations. Solar power generated is fully metered, and staff members at PNNL can access a graphic indicating real-time generation and statistics.

Figure 3.1. EMSL Photovoltaic Array

Another renewable energy project at PNNL is a solar hot water heater, which was installed in 2012 (Figure 3.2). Located on the roof of EMSL, the unit produces approximately 160,000 British thermal units (BTU)/hr of hot water.

Figure 3.2. EMSL Solar Hot Water Heater

3.3 Measurement and Verification

The requirement for measurement and verification is to "install building level electricity meters to track and continuously optimize performance." The section goes on to require natural gas and steam meters where natural gas and steam are used.

Electricity is delivered to the LSB building from a single service supplied by the City of Richland. The service is metered with a city-supplied utility meter and a PNNL-provided E-Mon D-Mon class 3000 datalogging meter. The city meter is read by city personnel while the E-mon meter uses an analog communication line to transfer data to the Decision Support for Operations and Maintenance (DSOM) system that collects metering data across the campus and serves it using interactive displays available to all employees. A trend example for electricity consumption at the LSB building is shown in Figure 3.3. No gas or steam is provided to the LSB building.

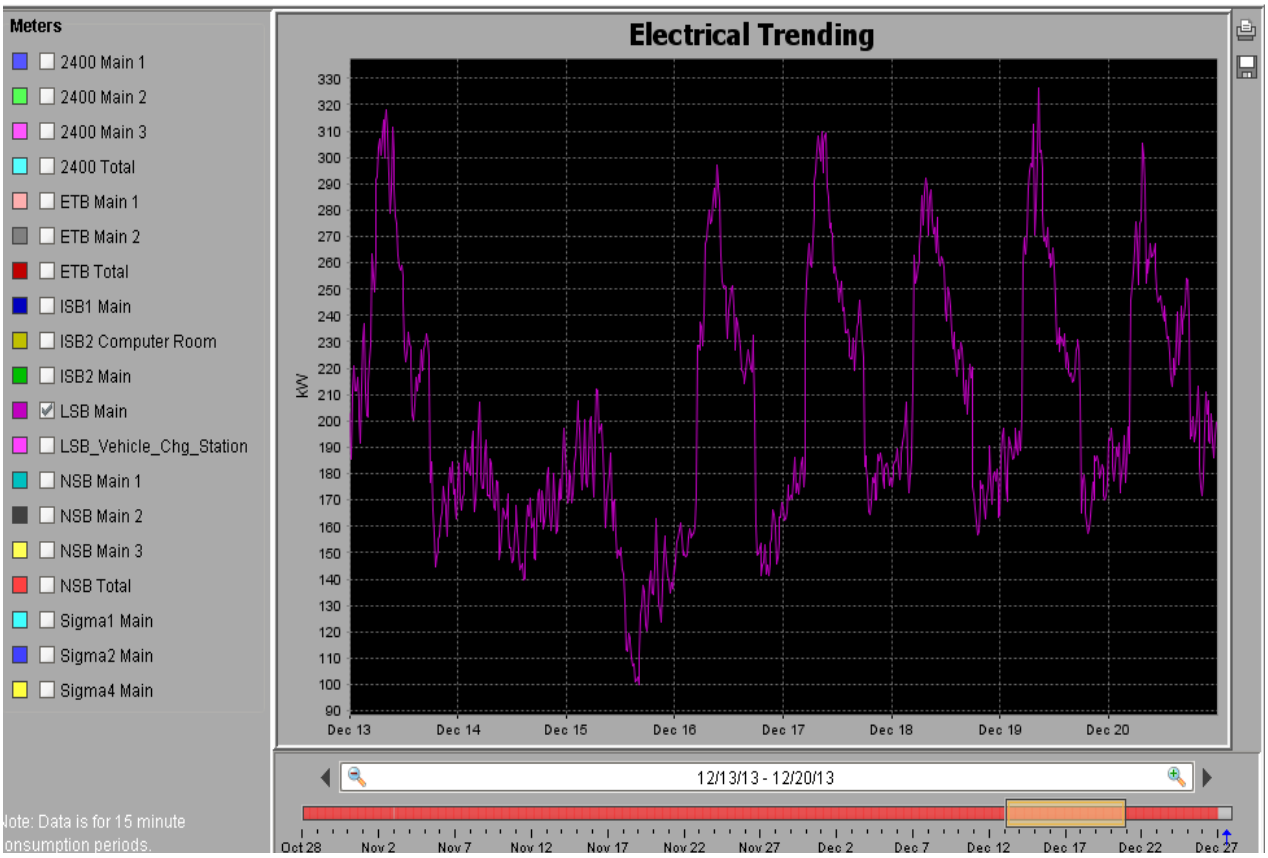

Figure 3.3. LSB Building Electrical Meter

3.4 Benchmarking

The Guiding Principle for benchmarking requires PNNL to "compare annual performance data with previous years' performance data." PNNL meets this requirement by collecting electricity, gas, and water data in a "Campus Energy Consumption" spreadsheet. Data are maintained through a partnership with the Energy and Environment Directorate (EED), a research organization within PNNL. Monthly meetings are held to discuss benchmarking goals, perform trend analysis, and identify opportunities for energy savings.

Meetings are conducted in the Building Operations Control Center, a state-of-the-art asset capable of displaying multiple trends simultaneously on oversize wall monitors and accessing real-time data. Attendees at these meetings typically include the building manager, one or more building engineers, the PNNL campus energy manager, and a sustainability engineer. Graphics are frequently used to illustrate benchmarking results and track progress toward energy goals. Examples of the trends used in the December benchmarking meeting are included in Figures 3.4, 3.5, and 3.6.

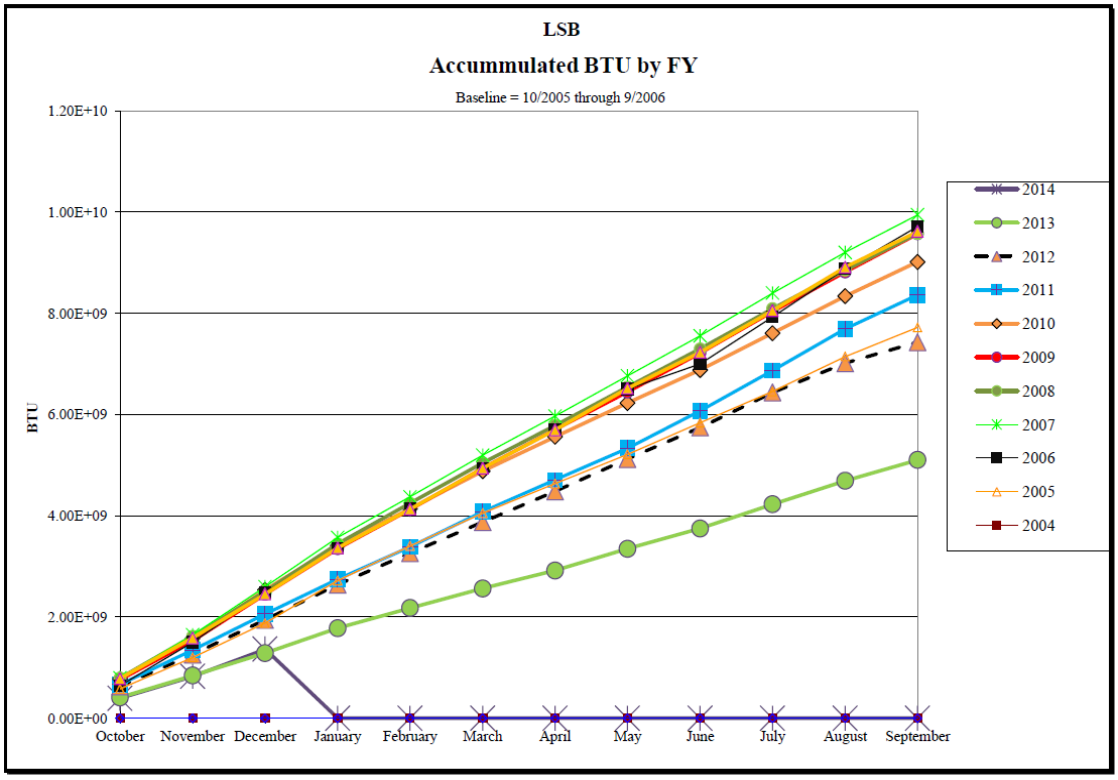

Figure 3.4. Accumulated BTU by FY

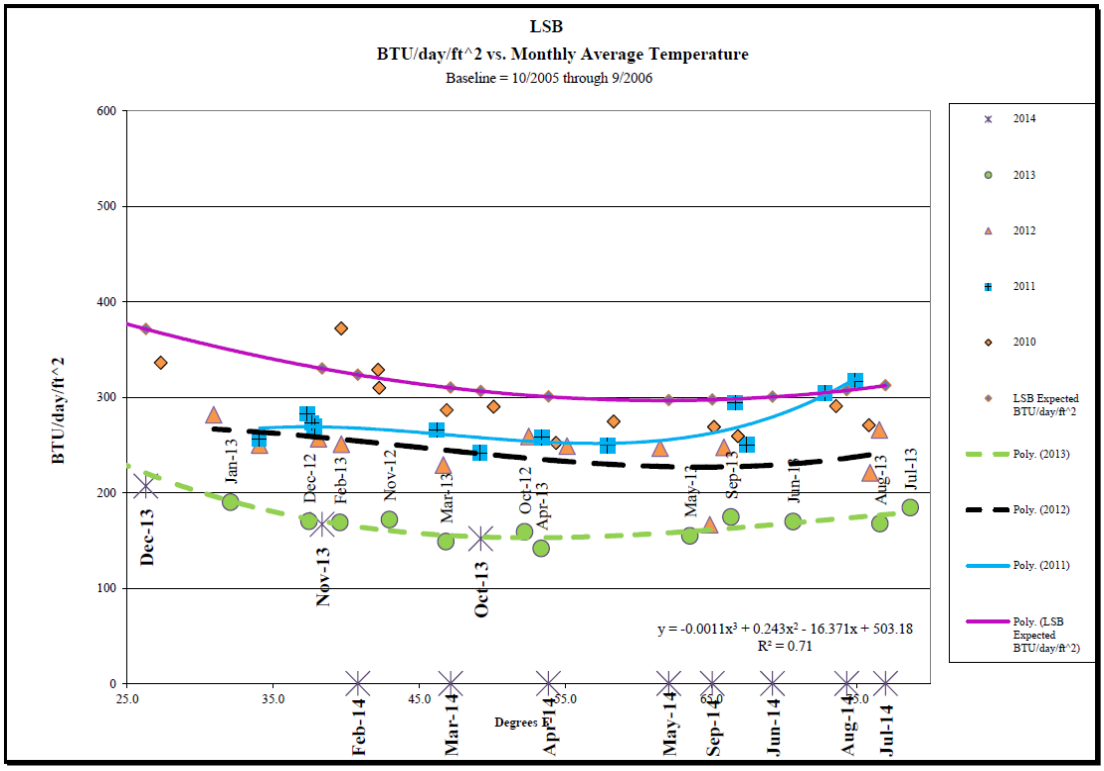

Figure 3.5. BTU/Day/Ft^2 vs. Monthly Average Temperatures

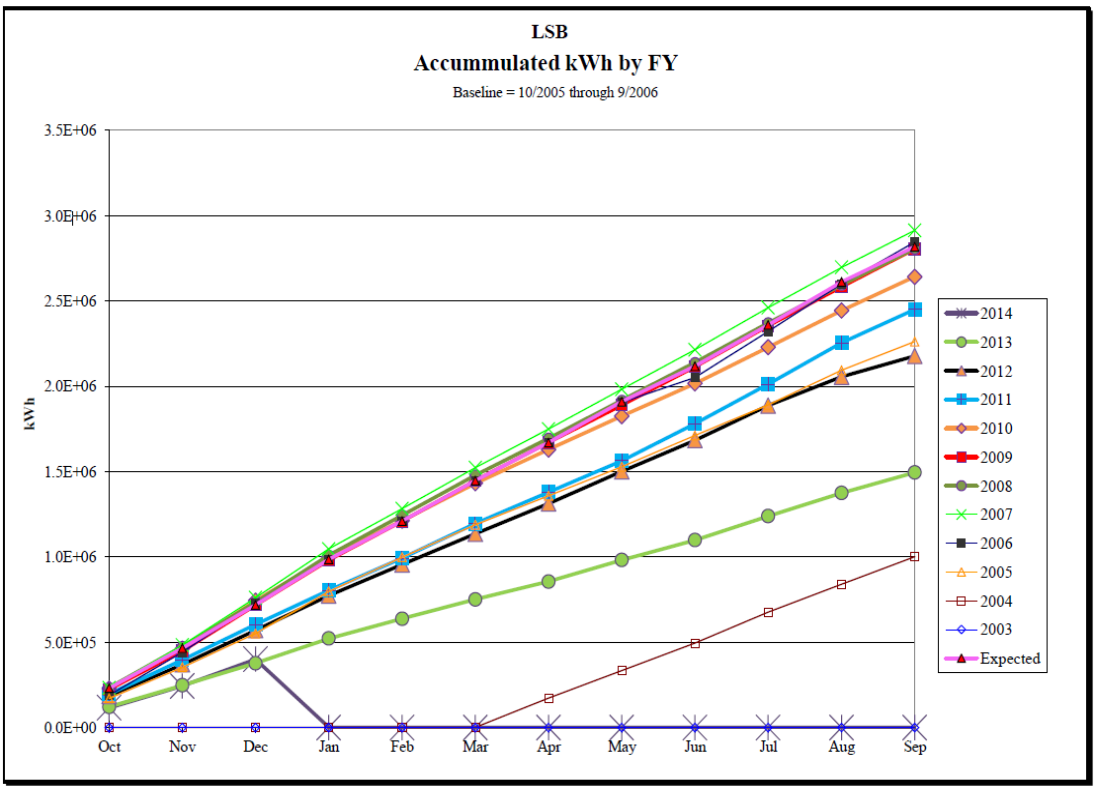

Figure 3.6. Accumulated kWh by FY

4.0 Guiding Principle Number Three

4.1 Indoor Water

The requirements for Guiding Principle Number Three, Indoor Water, allow for two options to be used to measure indoor potable water use performance as follows:

- Option 1: Reduce potable water use by 20% compared to a water baseline calculated for the building. The water baseline, for buildings with plumbing fixtures installed in 1994 or later, is 120% of the Uniform Plumbing Codes 2006 or the International Plumbing Codes 2006 fixture performance requirements. The water baseline for plumbing fixtures older than 1994 is 160% of the Uniform Plumbing Codes 2006 or the International Plumbing Codes 2006 fixture performance requirements, or
- Option 2: Reduce building measured potable water use by 20% compared to building water use in 2003 or a year thereafter with quality water data.

PNNL decided to pursue Option 2 to demonstrate the required reduction in water use at the LSB. FY 2007 is being used as the baseline year. Collected data are listed and graphically displayed in Table 4.1 and Figure 4.1.

Table 4.1. LSB Water Consumption

Year	Water (CCF)
FY 2007	2,025
FY 2008	1,080
FY 2009	1,031
FY 2010	875
FY 2011	898
FY 2012	1,088
FY 2013	955
Total Reduction	**53%**

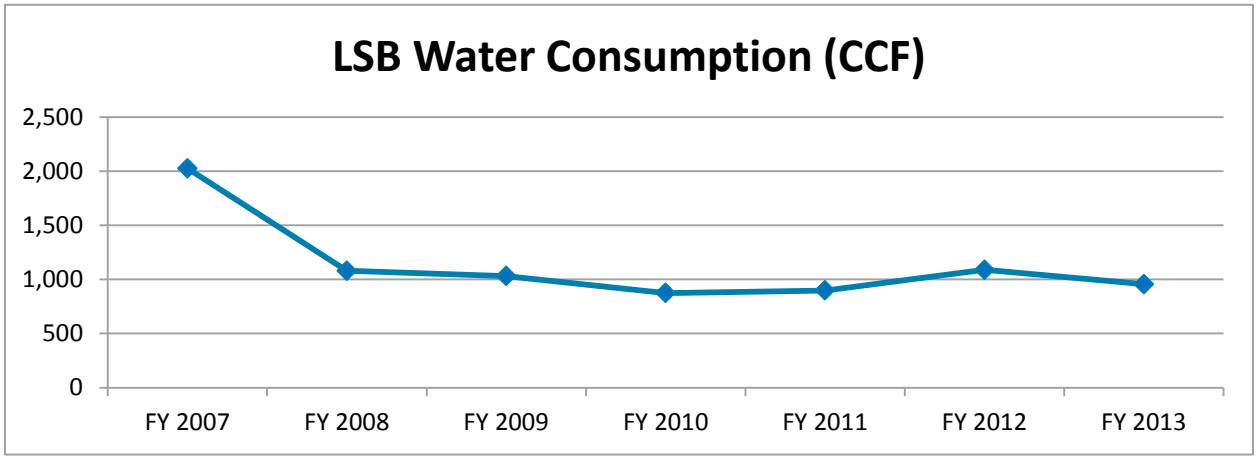

Figure 4.1. LSB Water Consumption

4.2 Outdoor Water

The requirements for Guiding Principle Number Three, Outdoor Water, allow for three options to be used to measure indoor potable water use performance as follows:

- Option 1: Reduce potable irrigation water use by 50% compared to conventional methods, or
- Option 2: Reduce building related potable irrigation water use by 50% compared to measured irrigation water use in 2003 or a year thereafter with quality water data, or
- Option 3: Use no potable irrigation water.

PNNL decided on Option 3 to demonstrate compliance with this principle. The LSB uses no potable water for irrigation. The sod and landscaping surrounding the LSB are irrigated with non-potable river water drawn from the Columbia River through a water right. Potable water to the site is supplied from the City of Richland.

4.3 Measurement of Water Use

This Guiding Principle encourages the installation of water meters for buildings with significant indoor and outdoor water use and the demonstration of a 20% reduction in potable water use. In addition, this Guiding Principle requires employment strategies that reduce storm water runoff and discharges of polluted water off site.

The LSB has a standard water meter supplied by the city at the potable water service entrance for the facility (Figure 4.2). City public works personnel read this meter and provide meter data with the bill.

Figure 4.2. Badger Water Meter at LSB

Aside from being a Guiding Principle requirement, metering at PNNL buildings is a contract deliverable requirement to DOE. Additional metering details, including our metering strategy and progress across the campus, are detailed in the PNNL *Metering Plan: Informed Decision Making Through Measuring and Monitoring of Utility Resource Consumption* (Pope 2014).

The water reduction goal has been achieved using a baseline year of 2007. No potable water is consumed outdoors at the LSB, so the indoor reduction totals (and therefore combined totals) are detailed in Section 4.1, Indoor Water. A total measured reduction of 53% from the baseline year fulfills the requirement.

The LSB has employed strategies to reduce storm water runoff and the discharge of polluted water off site. Redevelopment work on PNNL campus properties owned by DOE or Battelle are engineered using PNNL F&O procedure ADM-CM-057, PG-01, *Engineering Design Standards*. This procedure requires storm water runoff from all buildings and all parking areas to be collected and disposed of on site, with a combination of surface swales, underground infiltration beds (or percolation beds), and dry wells.

4.4 Process Water

This Guiding Principle requires lifecycle cost-effective water conservation measures be taken when potable water is used to improve a building's energy efficiency. The LSB does not have a cooling tower and uses no potable water to improve building energy efficiency. The LSB is an office building and does not have a process water loop as seen in laboratory buildings.

4.5 Water-Efficient Products

This Guiding Principle requires us to use the U.S. Environmental Protection Agency's (EPA) WaterSense-labeled products or other water conserving products, where available. It also requires that PNNL choose irrigation contractors who are certified through a WaterSense-labeled program.

PNNL chooses WaterSense-labeled products as part of the overall water reduction strategy at the LSB. Zurn's "The Pint" 0.125 gallon per flush, ultra-low consumption urinal systems were installed in restrooms. Low-flow faucets equipped with motion sensors were installed at restroom sinks. Examples of water-efficient products installed at PNNL are shown in Figure 4.3. The PNNL *Engineering Design Standards* requires the use of WaterSense-labeled or other water conserving products for future renovations or fixture replacements.

Figure 4.3. Water-Efficient Products Installed at the LSB

Cowperwood contracts with SunScapes Inc. for irrigation and landscaping services at the LSB. As part of the HPSB effort, SunScapes vice president David Patterson completed the requirements to be listed as a WaterSense partner in the EPA's WaterSense program (Figure 4.4). Mr. Patterson is certified as a Landscape Irrigation Auditor.

Figure 4.4. Irrigation and Landscaping EPA Certification

5.0 Guiding Principle Number Four

5.1 Ventilation and Thermal Comfort

This Guiding Principle requires the LSB to meet ASHRAE Standard 55-2004-3, *Thermal Environmental Conditions for Human Occupancy* and ASHRAE Standard 62.1-2007, *Ventilation for Acceptable Indoor Air Quality*.

To validate that the LSB meets the thermal conditions for human occupancy specified in ASHRAE Standard 55-2004, existing temperature sensors located throughout the building were used. Ten sensors located throughout the building on the perimeter and interior on the first and second floor were chosen for examination. One year's worth of data at each sensor measured every 15 minutes was analyzed, almost 115,000 measurements. The data points were plotted and compared to the minimum and maximum acceptable temperatures of 68°F and 80°F. Data points were in the acceptable range 99.70% of the time, with no individual sensor being in the acceptable range less than 98.26% of the time. Using this method, it was determined that all of the spaces analyzed in the LSB exhibited acceptable thermal environmental conditions. An example of this method is shown in Figure 5.1.

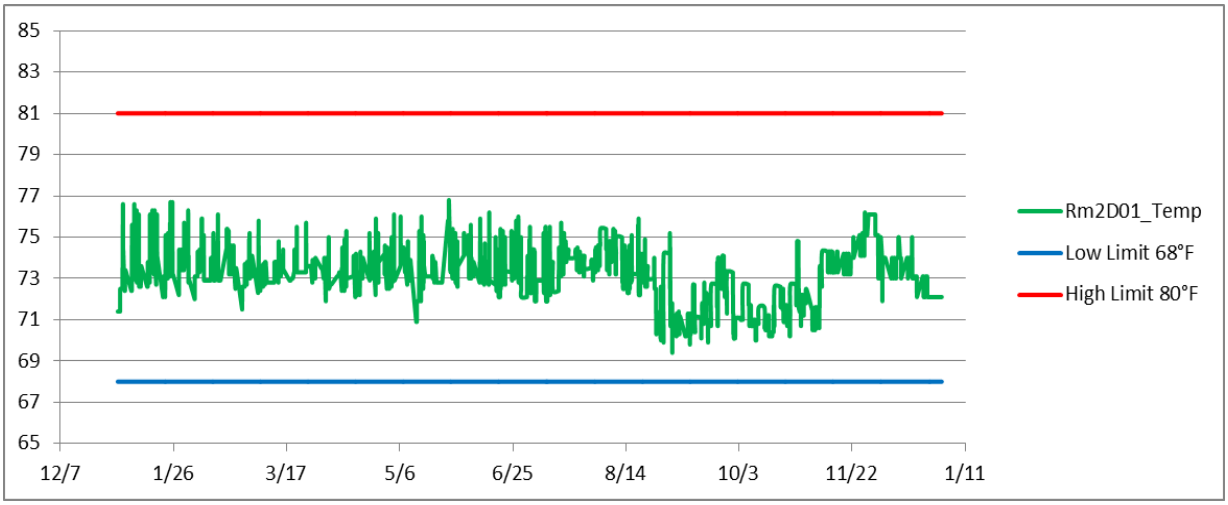

Figure 5.1. Sample Trace Showing 1 Year of Temperature Data in LSB Rm 2D01

An analysis on the LSB ventilation system based on ASHRAE 62.1-2007 was performed in 2014. The analysis was conducted by Tony James, a research engineer in the EED at PNNL. His findings are detailed in a report indicating compliance with the ASHRAE standard and is available on request.

5.2 Moisture Control

This Guiding Principle requires PNNL to provide policy and illustrate the use of an appropriate moisture control strategy to prevent building damage, minimize mold contamination, and reduce health risks related to moisture.

Cowperwood has a Moisture Control Policy with a stated goal and scope consistent with the requirements of this Guiding Principle. Available upon request, this policy outlines procedures and strategies used in

the LSB to identify and prevent moisture infiltration. Cowperwood also uses NetFacilities software package to issue and track work orders in their facilities. A monthly building inspection work order guides maintenance staff in the inspection of items that could cause moisture damage if left undetected. Inspections include:

- Checking for condensation or dampness around windows and other exterior wall penetrations
- Ensuring landscaping and guttering directs water away from the building
- Ensuring HVAC condensate pans are clean, flowing properly, and unobstructed
- Checking for plumbing leaks and indoor sources of moisture
- Checking building foundation for dampness.

Also contributing to moisture control at the LSB building is the original building construction that minimizes the opportunity for moisture buildup and damage. The hard exterior reduces the possibility of moisture infiltration from rain or snow (Figure 5.2). The dry Richland, WA climate receives less than 8 inches of rainfall annually and 6 inches of snowfall, lending itself to healthy buildings and conversations, with the building manager and technicians uncovering no instances of damage from moisture in this facility. The site is properly graded to drain moisture away from the building, and the parking lots are sloped to direct rain and melted snow to drains.

Figure 5.2. Exterior of the LSB

5.3 Daylighting and Lighting Controls

This Guiding Principle requires that automated lighting controls, such as occupancy/vacancy sensors with manual-off capability, are provided for appropriate spaces, including restrooms, conference and meeting rooms, employee lunch and break rooms, training classrooms, and offices. Additionally, this Guiding Principle requires that either a 2% daylighting factor is achieved or that 50% of regularly occupied spaces have occupant-controlled lighting that allows adjustments to suit individual task needs.

The LSB is comprised primarily of office space and associated restrooms and conference rooms. The long, narrow architecture and abundant windows contribute to a significant lighting contribution from daylighting. Much of the square footage is an open office layout with cubicles, allowing sunlight to penetrate into the building. As a result of this Guiding Principle effort, occupancy or vacancy sensors are now installed in all eight restrooms, all 19 conference rooms, the sole training classroom, and all 52 hard-walled offices. The LSB does not have lunch or break rooms.

To meet the second portion of this requirement, the LSB was surveyed for occupant-controlled lighting. Results indicated 73% of the 302 cubicles and 54% of the offices in the building had task lighting that allowed occupant control. The building total results in 70% of regularly occupied spaces with occupant-controlled lighting that allows adjustment to suit individual task needs, well in excess of the required 50%.

5.4 Low-Emitting Materials

This Guiding Principle requires the use of low-emitting materials for building modifications, maintenance, and cleaning.

As mentioned earlier, the LSB building is owned by Cowperwood and leased to PNNL. Some activities where low-emitting materials would apply are performed by the building owner, and some are performed by PNNL. The building owner is responsible for most maintenance and the occasional modification. Two typical maintenance activities that occurred recently were examined to determine if low-emitting materials were used. The building owner performs interior painting as necessary using Sherwin Williams Interior Latex Eg-Shel Treasure Valley Extra White paint. The Certified Environmental Data Sheet lists product attributes. There is no regulatory definition for “zero,” “low,” “formaldehyde-free,” or “low-toxic” volatile organic compound (VOC) paint. The Sherwin Williams product used is not listed as containing formaldehyde in the environmental data sheet. It is water-based, which is lower in VOCs than solvent-based. At 41grams per liter (g/L) total VOC content and 92 g/L less exempt solvents, the VOC content is lower than the VOC limit to qualify for the LEED IEQ credit 4.2 for paints and coatings. The VOC limit (g/L minus water) as referenced in the Green Seal GS-11, 1993 Standard for Interior Non-Flat Coatings is 150 g/L.

The second activity examined was carpet replacement throughout the entire building performed in 2011. The carpet tile system and adhesive used was Nexterra by Bolyu. Nexterra is certified through the NSF 140 standard, a multi-product testing protocol for identifying sustainable products, and the Carpet and Rug Institute (CRI) Green Label Plus Certified for good indoor air quality. The adhesive is listed as emitting zero VOCs.

Janitorial services in the LSB are performed by PNNL janitorial staff. The PNNL Green Housekeeping Policy, available upon request, outlines PNNL's holistic approach to facility cleaning, going beyond appearances to focus on health and environmental impacts. The policy implementation details the product standards given preference when purchasing and using cleaning and floor service products. These standards include the following:

- Green Seal Standard GS-37 (www.greenseal.org)
- Where GS-37 is not applicable, California Code of Regulations maximum allowable VOC levels (www.calregs.com)
- CRI Seal of Approval requirements for spot removers and pre-spray/ in-tank cleaning solutions.

In addition to the Green Housekeeping Policy, low-emitting purchasing is a required part of PNNL's sustainable acquisitions program, which embeds purchase of low-emitting material within the contracting and ordering process. Furniture and furnishings in the LSB are purchased by PNNL and are subject to PNNL ordering requirements. The Environmental Protection and Regulatory Programs (EPRP) Division at PNNL discusses these and other procurements on its Sustainable Acquisition webpage. PNNL Acquisition Guideline 24, "Sustainable Acquisitions," requires purchasing decisions for designated products to be consistent with the guidelines it sets. Furnishings are required to be Greenguard Indoor Air Quality certified.

5.5 Integrated Pest Management

This Guiding Principle requires the use of integrated pest management techniques, as appropriate, to minimize pesticide usage. It also requires PNNL to use EPA-registered pesticides only when needed.

Cowperwood contracts with Complete Pest Prevention, Inc. for pest management services. Complete Pest Prevention administers an integrated pest management program and highlights their interaction with the property management team and understanding of the property and insect levels associated with the area as critical factors. As an example, they use a least-risk approach in treatments to reduce spider buildup in the LSB. By physically sweeping down webbing, less material is required, and applications have been reduced to twice (rather than four times) per year typical for this type of facility.

Complete Pest Prevention uses EPA-registered products as needed and emphasizes baiting strategies.

5.6 Environmental Smoke Control

This Guiding Principle prohibits smoking within the building and within 25 feet of all building entrances, operable windows, and building ventilation intakes.

PNNL has implemented a set of "Basic Staff Practices." This work control includes the basic requirements and considerations for being employed by PNNL as well as for work activities in PNNL-operated work environments. Within the Staff Responsibilities and Limitations, Security Requirements, and use of PNNL Facilities section lies the following requirement:

> Do not smoke inside any building or within 25 feet from building entrances, exits, windows that open, and ventilation intakes that serve a building.

6.0 Guiding Principle Number Five

6.1 Recycled Content

The Recycled Content requirement reads as follows:

> Per Section 6002 of the Resource Conservation and Recovery Act (RCRA) (PDF), for EPA-designated products, use products meeting or exceeding EPA's recycled content recommendations for building modifications, maintenance, and cleaning. For other products, use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost or weight) of the total value of the materials in the project. If EPA-designated products meet performance requirements and are available at a reasonable cost, a preference for purchasing them shall be included in all solicitations relevant to construction, operation, maintenance of or use in the building. EPA's recycled content product designations and recycled content recommendations are available on EPA's Comprehensive Procurement Guideline website.

PNNL has a mature sustainable acquisitions program that embeds the purchase of items containing recycled content within the contracting and ordering process. PNNL Acquisition Guideline 24, "Sustainable Acquisitions," requires purchasing decisions for designated products to be consistent with the EPA procurement guidelines. Exhibit 1 to Acquisition Guideline 24 dictates specific content requirements for office, janitorial, transportation, vehicular, and miscellaneous products.

As a resource, the procurement department has assigned a sustainable acquisitions subject matter expert (SME) to consult with when purchasing products containing recycled content. The SME ensures compliance with applicable requirements and guidelines, such as this Guiding Principle.

Compliance with Acquisition Guideline 24, Section 3.0, "Recycled Content," is checked during the electronic procurement process in the E-Pro Risk Assessment Checklist. Purchasers must check the box associated with checklist item 22, indicating that purchase is consistent with recycled content requirements.

The Guiding Principle allows for exceptions to the recycled content requirement based on "reasonable cost." The exception process at PNNL is detailed in Acquisition Guideline 24, Section 2.4. Exceptions are requested by the technical oversight representative and evaluated by the sustainable acquisitions SME. Granted exceptions are documented in the contract as a modification of Clause 381, "Sustainable Acquisition Requirements," and the circumstances of the exception are addressed in the Memorandum of Procurement.

Because the LSB is a leased building, not all purchases are made for the building are subject to the PNNL acquisition guidelines. PNNL purchases furniture, computers, and office supplies; provides janitorial service and all cleaning supplies; and provides vehicles. Building owner Cowperwood performs building modifications and substantial maintenance. The most recent large maintenance activity that could be checked for recycled content was the building-wide carpet replacement in 2011. The Nexterra by Bolyu carpet chosen contains a minimum of 40% post-consumer recycled content measured as a percentage of average total carpet tile weight, among the highest in the industry and meeting the recycled content expectation of this Guiding Principle.

6.2 Biobased Content

The Biobased Content requirement reads as follows:

> Per Section 9002 of the Farm Security and Rural Investment Act (FSRIA), for U.S. Department of Agriculture (USDA)-designated products, use products with the highest content level per USDA's biobased content recommendations. For other products, use biobased products made from rapidly renewable resources and certified sustainable wood products. If these designated products meet performance requirements and are available at a reasonable cost, a preference for purchasing them should be included in all solicitations relevant to construction, operation, maintenance of or use in the building. USDA's biobased product designations and biobased content recommendations are available on USDA's BioPreferred website.

PNNL has a mature sustainable acquisitions program that embeds the purchase of items containing biobased content within the contracting and ordering process. PNNL Acquisition Guideline 24, "Sustainable Acquisitions," requires purchasing decisions for designated products to be consistent with USDA procurement recommendations. Exhibit 1, Section 2, of Acquisition Guideline 24 dictates specific content requirements in 66 categories.

As a resource, the procurement department has assigned a sustainable acquisitions SME to consult with when purchasing products containing biobased content. The SME ensures compliance with applicable requirements and guidelines, such as this Guiding Principle.

Compliance with Acquisition Guideline 24, Section 4.0, "Biobased Content," is checked during the electronic procurement process in the E-Pro Risk Assessment Checklist. Purchasers must check the box associated with checklist item 22, indicating that purchase is consistent with biobased content requirements.

The Guiding Principle allows for exceptions to the biobased content requirement based on "reasonable cost." The exception process at PNNL is detailed in Acquisition Guideline 24, Section 2.4. Exceptions are requested by the technical oversight representative and evaluated by the sustainable acquisitions SME. Granted exceptions are documented in the contract as a modification of Clause 381, "Sustainable Acquisition Requirements," and the circumstances of the exception are addressed in the Memorandum of Procurement.

6.3 Environmentally Preferable Products

This Guiding Principle requires the use of products that have a lesser or reduced effect on human health and the environment over their lifecycle when compared with competing products or services that serve the same purpose. PNNL has implemented policies and procedures to meet this requirement when purchasing goods and services. PNNL Acquisition Guideline 24, "Sustainable Acquisitions," outlines Battelle's plan to comply with Clause H-43 of its 1830 Contract pertaining to the acquisition of environmentally preferable products and services and energy-efficient products, as required by EOs 13514 and 13423.

The six main categories of environmentally preferable products are recycled content products, biobased products, energy- and water-efficient products, computer products registered with the EPA's Electronic

Product Environmental Assessment Tool (EPEAT), and non-ozone-depleting products. Most of these six product types are discussed elsewhere in this Guiding Principle document.

PNNL purchases computing products that are used in the LSB, including desktop and laptop computers and monitors that are registered with EPEAT, unless there is no standard for the product. EPEAT is managed by the Green Electronics Council of the EPA. In 2012, PNNL purchased 835 desktop computers, 799 LCD monitors, and 691 laptop computers, all registered as EPEAT Gold. PNNL purchased an additional 14 LCD monitors registered as EPEAT silver and another 24 desktop and 37 laptop computers that were ENERGY STAR® qualified but not EPEAT registered.

No computers or monitors were purchased that did not qualify for an ENERGY STAR® rating or EPEAT registration. By ordering computers through the PNNL managed hardware system, purchasers are able to ensure only computers meeting the Acquisition Guideline are procured.

6.4 Waste and Materials Management

This Guiding Principle requires PNNL to provide reuse and recycling services for building occupants, where markets or on-site recycling exist. It provides for salvage, reuse and recycling services for waste generated from building operations, maintenance, repair and minor renovations, and discarded furnishings, equipment and property. This could include such things as beverage containers and paper from building occupants, batteries, toner cartridges, outdated computers from an equipment update, and construction materials from a minor renovation.

PNNL has a genuine commitment to pollution prevention and recycling. In 2013, PNNL donated or transferred 1,370 desktop computers, 393 laptop computers, and 68 LCD monitors, allowing for reuse rather than sending them to the landfill. Lab-wide, 1,708 metric tons of construction and demolition waste and debris was diverted from the landfill, leaving only 2 metric tons designated as landfilled waste. In the municipal solid waste category consisting of trash and organics generated by normal housekeeping activities, PNNL diverted 615 metric tons from the landfill, composted an additional 65.6 metric tons offsite, and composted another 1 metric tons on site.

The LSB has reuse and recycling services available to all staff. Locations for LSB recycling are detailed in Table 6.1. Recycling services are available for aerosol cans, aluminum, tin, glass, plastic, batteries, cardboard, cell phones, compost, electronic media (CDs, video and cassette tapes, diskettes, etc.), eye glasses, hearing aids, hardbound books, paper, lamps, printer cartridges, office products and furnishings, wood, and more.

Details on waste and materials management can be found in the PNNL Solid Waste Management Policy, which sets specific goals for waste diversion, reuse, and recycling. The policy also identifies the PNNL Pollution Prevention Program manager and Excess Material & Redeployment manager.

Table 6.1. LSB Recycle Locations

Floor	Space	Container Type	Placement Description
1	1A12	Aluminum	Vending
1	1C24	Aluminum	Vending
2	2B59	Aluminum	Mt. Baker
2	2A01	Aluminum	Red Mountain
2	2D15	Aluminum	D. Koontz office
2	2C26	Aluminum	Vending
2	2A16	Aluminum	Vending
2	2B32	Aluminum	Mt. Jupiter
2	2A01	Aluminum/Plastic	Red Mountain
2	2B59	Aluminum/Plastic	Mt Baker
2	2D03	Aluminum/Plastic	Mt. Hood
2	2C22	Aluminum/Plastic	Mt. Shukson
2	2C58	Aluminum/Plastic	Rattlesnake Mountain
1	1A14	Aluminum/Plastic	Mt. Adams
1	1B02	Aluminum/Plastic	Inside room
1	1B40	Aluminum/Plastic	Mt. Rainier
1	1B45	Aluminum/Plastic	Candy Mountain
2	2B27	Aluminum/Plastic	Mt. Tahoma
1	1C59	Catalog bin	Dock area
2	2C27	Catalog bin	Copy area between the two “C” hallways
1	1A13	Catalog bin	Copy room
2	2A16	Catalog bin	Vending
1	1C01	Catalog bin	Elevator entrance
1	1A13	Electronic media	Copy room
1	1A13	Paper, shred	Copy room
1	1C24	Paper, shred	Vending
2	2B59	Paper, shred	Mt. Baker
1	1C59	Paper, shred	Dock area
1	1C01	Paper, shred	Elevator entrance
2	2C46	Paper, shred	Storage space
1	1C44	Paper, shred	Mail room
1	1D04	Paper, shred	Document Center
2	2D28	Paper, shred	Plotter room
2	2C27	Paper, shred	Copy area between the two “C” hallways
2	2C26	Plastic	Vending
1	1C01	Plastic	Elevator entrance
2	2A16	Plastic	Vending
1	1C24	Plastic	Vending
1	1A12	Plastic/Tin/Glass	Vending
2	2A16	Tin/Glass	Vending
1	1C24	Tin/Glass	Vending
2	2C26	Tin/Glass	Vending

6.5 Ozone-Depleting Compounds

This Guiding Principle requires PNNL to eliminate the use of ozone-depleting compounds where alternative environmentally preferable products are available, consistent with either the Montreal Protocol and Title VI of the Clean Air Act Amendments of 1990 or equivalent overall air quality benefits that take into account lifecycle impacts.

The LSB currently operates units containing hydrochlorofluorocarbon (HCFC) refrigerants. HCFCs are identified in the 1992 amendment to the Montreal Protocol as less damaging to the ozone layer than chlorofluorocarbons (CFC) but still containing ozone-destroying chlorine. A schedule of units and their associated refrigerants is shown in Table 6.2.

Table 6.2. LSB Refrigeration Units

Unit	Refrigerant	Size	Serving
RTU-1	R-22	90T	Main building east
RTU-2	R-22	90T	Main building west
Split Unit - 1	R-22	5 1/2T	Deli
Split Unit - 2	R410A	5 1/2T	1C04

As amended, the Montreal Protocol is carried out in the United States through Title VI of the Clean Air Act. Under the terms of the Montreal Protocol, there is a phaseout schedule for HCFCs, including R-22. PNNL is committed to the elimination of ozone-depleting compounds on its campus. Considering lifecycle impacts, older units using HCFCs will be replaced with newer units using an alternative refrigerant. The EPA allows units with an R-22 refrigeration system that were constructed before January 1, 2010 to be operated and maintained. As units require replacement or as a result of a changing mission need, existing equipment will be replaced with equipment that uses approved HCFC alternatives as required by the Clean Air Act.

7.0 References

ASHRAE—American Society of Heating, Refrigerating, and Air-Conditioning Engineers. 2010. Standard 55-2004-3 – Thermal Environmental Conditions for Human Occupancy. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, GA.

ASHRAE—American Society of Heating, Refrigerating, and Air-Conditioning Engineers. 2007. Standard 62.1-2007 – Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, GA.

ASHRAE—American Society of Heating, Refrigerating, and Air-Conditioning Engineers. 2007. Standard 90.1-2007 – Energy Standard for Buildings Except Low-Rise Residential Buildings. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, GA.

EERE—Energy Efficiency & Renewable Energy. 2007. "Section 432: Federal Facility Management and Benchmarking Requirements," Energy Independence and Security Act. EERE, U.S. Department of Energy, Washington, D.C.

EO—Executive Order. 2007. 13423, "Strengthening Federal Environmental, Energy, and Transportation Management." The White House, *Federal Register*. January 24.

EO—Executive Order. 2009. 13514, "Federal Leadership in Environmental, Energy, and Economic Performance." The White House, *Federal Register*. October 5.

EPA—U.S. Environmental Protection Agency. 1990. "Title IV – Stratospheric Ozone Protection," Clean Air Act Amendment. U.S. Environmental Protection Agency, Washington, D.C.

Montreal Protocol. 1987. *The Montreal Protocol on Substances that Deplete the Ozone Layer*. Vienna Convention for the Protection of the Ozone Layer. September 16.

PNNL—Pacific Northwest National Laboratory. 2013. *Basic Staff Practices*. HDI Work Control, Pacific Northwest National Laboratory, Richland, WA.

PNNL—Pacific Northwest National Laboratory. 2013. F&O Administrative Procedure: *Managing Sustainability Program Requirements*. ADM-142, Pacific Northwest National Laboratory, Richland, WA.

PNNL—Pacific Northwest National Laboratory. 2013. F&O Standard Operating Procedure: *325 Operator Rounds*. SOP-325-RND-01, Pacific Northwest National Laboratory, Richland, WA.

PNNL—Pacific Northwest National Laboratory. 2013. *PNNL Acquisition Guideline 24: Sustainable Acquisitions*. Pacific Northwest National Laboratory, Richland, WA.

PNNL—Pacific Northwest National Laboratory. 2013. *Site Sustainability Plan: An Authentic Commitment*. September 26. PNNL-22109, Pacific Northwest National Laboratory, Richland, WA.

PNNL—Pacific Northwest National Laboratory. 2013. *F&O Administrative Procedure: Engineering Design Standards*. ADM-CM-057, PG-01. Pacific Northwest National Laboratory, Richland, WA.

Pope JE. 2014. *Metering Plan: Informed Decision Making Through Measuring and Monitoring of Utility Resource Consumption*. PNNL-23494, Pacific Northwest National Laboratory, Richland, WA.

For more information about this report, contact:

Jason Pope, P.E.
Energy Management Program
Pacific Northwest National Laboratory
P.O. Box 999, MSIN J2-33
Richland, WA 99352
Tel: 509-375-7545
Fax: 509-371-7030
jason.pope@pnnl.gov

Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by **Battelle** *Since 1965*

U.S. DEPARTMENT OF
ENERGY

902 Battelle Boulevard
P.O. Box 999
Richland, WA 99352
1-888-375-PNNL (7665)

www.pnnl.gov