Labs21 Environmental Performance Criteria 3.0

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Overview

Laboratory facilities present a unique challenge for energy efficient and sustainable design, with their inherent complexity of systems, health and safety requirements, long-term flexibility and adaptability needs, energy use intensity, and environmental impacts. The Labs21 Environmental Performance Criteria (EPC) complements the U.S. Green Building Council's widely used Leadership in Energy and Environmental Design for New Construction (LEED-NC) rating system, extending it to set appropriate and specific requirements for laboratories. The EPC is a public domain document that is available for anyone to use in their laboratory projects.

The EPC was developed by the Laboratories for the 21st Century (Labs21) Program (http://www.labs21century.gov/). Labs21 is aimed at improving environmental performance of laboratory buildings. The lead sponsors of the Labs21 Program are the U.S. Department of Energy's Federal Energy Management Program (FEMP) and the U.S. Environmental Protection Agency (EPA).

Using the EPC

The EPC should be used in conjunction with LEED-NC 2009. The EPC only addresses environmental performance factors that are not addressed by LEED-NC 2009. The EPC credits include "EPC" in the credit label prefix to distinguish them from LEED credits.

Projects that are pursuing LEED certification may consider submitting the EPC credits as innovation points. Labs21 does not provide a certification process for the EPC.

Changes in Version 3.0

Version 3.0 is a substantial revision of the earlier version of the EPC to better align with LEED 2009 and developments in industry practice over the last few years. Some of the key changes include the following:

- Deleted the sustainable sites credit for liquid effluents as this is covered in the EPC prerequisite for hazardous material handling.
- Added a credit for process water metering.
- Changed the approach for the laboratory equipment efficiency credit to make it more usable and specified a list of qualifying equipment.
- Added a requirement in the laboratory right sizing credit to develop a plan to meter laboratory equipment energy use and add these data to the Labs21 database.
- Changed the EPC credit for protection and notification systems to a prerequisite.

EPC version 3.0 has a total of 7 credits and 5 prerequisites.

Sustainable Sites

SS EPC Credit 1 **Safety and Risk Management for Air Effluents**

Intent

Minimize environmental, safety and health impacts of laboratory exhausts on site and neighbors.

Requirement

Meet all standards and generally accepted guidelines for outdoor protection of workers and general public from airborne chemical, radioactive and biological hazards. Use mathematical modeling, physical modeling and/or post-construction testing and certification to prove compliance. Use effluent controls that minimize generation of waste subject to special regulations.

Strategies

To protect workers: Meet or exceed all exposure limits established by American Conference of Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), Nuclear Regulatory Commission (NRC), American National Standards Institute (ANSI), local standards or generally accepted best practice, whichever are most stringent. The requirement applies on rooftops, catwalks and all other areas which workers may reasonably occupy with systems in operation.

To protect visitors and the public: Meet or exceed all exposure limits established by EPA, other organizations, local standards or generally accepted best practice, whichever are most stringent. In the absence of guidance or defensible rationale, use 10 percent of the applicable workplace limit as a standard for visitor and public exposure.

If the occupant's radiation safety staff requires air effluent precautions, verify that methods used to limit chemical exposures are adequate to protect against radioactive material releases or include additional precautions.

Meet or exceed National Institutes of Health – Centers for Disease Control (NIH-CDC) guidelines for airborne effluent from laboratories that handle biohazards (CDC-NIH. Biosafety in Microbiological and Biomedical Laboratories, latest edition).

Develop credible worst-case assumptions of airborne releases. Then use mathematical (e.g. Computational Fluid Dynamics (CFD)) and/or physical (e.g. wind tunnel) modeling to show that any target location (rooftop worker, operable window, air intake, pedestrian walk, etc.) will not be exposed to levels exceeding one-tenth of the appropriate standard with a probability greater than 0.0001 in any 7 day period i.e. one minute per week and/or verify safe building performance by post-construction tracer gas studies under a variety of weather conditions and correct design problems immediately.

Use filters only where justified. Avoid fiberglass or other duct liner exposed to exhaust stream. Select air cleaning systems for low waste generation as well as effectiveness. Test and certify all filters as installed prior to occupancy and placard them for at least annual re-certification.

Water Efficiency

WE EPC Prerequisite 1 **Laboratory Equipment Water Use**

Intent

Reduce water use for laboratory equipment.

Requirements

No potable water shall be used “once-through” for any laboratory equipment, unless it is required as direct contact process water.

Definitions

Direct contact process water is defined as any water that, during use, comes into direct contact with any raw material, product, or waste.

Strategies

Use closed-loop cooling water for equipment cooling.

Use non-potable water sources.

Use vacuum pumps instead of aspirator fittings at cold-water faucets. One way to encourage this is to specify the use of non-threaded faucets, unless threaded faucets are required for other laboratory functions

WE EPC Credit 1 **Process Water Efficiency**

Intent

Reduce process water use and process wastewater generation.

Requirements

Calculate and document baseline of annual process water use and process wastewater discharge. The baseline for the proposed facility must be completed before any of the credits may be earned. Methods used to establish a baseline may include: measurement and comparisons of process water use at similar laboratories, and evaluation of the typical water use for laboratory equipment and processes. The method used to develop the baseline must be included with documentation of this credit.

Credit 1.1 (1 point): Install meter to measure total laboratory process water use. Any individual use that is estimated at more than 30% of total process water use should be sub-metered.

Credit 1.2 (1 point): Adopt technologies and strategies to reduce process water use and process wastewater generation by 20%. Document the reductions from baseline.

Credit 1.3 (1 point): Adopt technologies and strategies to reduce process water use and process wastewater generation by 30%. Document the reductions from baseline.

Definitions

Process water is defined as any water that is used in the laboratory.

Strategies

Employ technologies/methodologies based on Pollution Prevention hierarchy – reduce, reuse, recycle.

Treat process wastewater so that is can be downcycled for use in cooling towers, etc.

Apply segregation – especially in baths – so that materials are separated from process water. This also recovers materials and thereby reduces overall material use.

Reduce water use for wash-up by using efficient floor wash machines instead of hosing.

Work with scientists and researchers to modify process to reduce water use (if feasible and does not interfere with science).

Energy & Atmosphere

EA EPC Prerequisite 1 **Assess Minimum Ventilation Requirements**

Intent

Optimize minimum ventilation requirements in laboratories based on user requirements, health/safety protection and energy consumption.

Requirements

The ventilation requirements shall be determined and documented by a team including each of the following professionals: A/E Team, Laboratory Consultants*, User Representative, Owner Facilities Group, Owner Environmental Health & Safety, Commissioning Authority*, Construction Manager* (*If these have not been appointed, an individual who independently and conscientiously represents these interests.)

The team shall, at a minimum, do the following:

- Determine the necessary fresh air ventilation rate and number of fume hoods and other exhaust devices based on applicable codes and the planned use of the laboratory over the next 5 years.
- Consider different types of fume hoods and exhaust alternatives to fume hoods, such as instrument exhausts and ventilated storage cabinets with very low flow ventilation and good ergonomic accessibility.
- Develop a fume hood sash management plan including: a) Informational placards for hoods; b) Awareness and Use Training. The Sash Management Plan should be incorporated in the Chemical Hygiene Plan for the laboratory.

The process and findings should be documented.

Strategies

See the Labs21 Best Practice Guide on Optimizing Ventilation Rates. http://www.labs21century.gov/toolkit/bp_guide.htm

EA EPC Credit 1 **Improve Laboratory Equipment Efficiency**

Intent

Save energy with efficient laboratory equipment.

Requirement

Calculate and document baseline energy use of all qualifying laboratory equipment. The baseline must be completed before any of the credits may be earned. The method used to develop the baseline must be included with documentation of this credit.

Credit 1.1 (1 point): Use energy efficient technologies and strategies to reduce total energy use of qualifying laboratory equipment by 10%. Document the reductions from baseline.

Credit 1.2 (1 point): Use energy efficient technologies and strategies to reduce total energy use of qualifying laboratory equipment by 20%. Document the reductions from baseline.

Definitions

Qualifying laboratory equipment for this credit includes: Refrigerators, freezers, autoclaves, water baths, incubators, ovens, centrifuges, growth chambers, chromatographs, glass washers, spectrometers, thermal cyclers, vacuum pumps, process coolers.

Strategies

Use ENERGY STAR labeled equipment where available.

Since equipment energy use can differ significantly across different laboratory types, an industry wide baseline does not exist. Work with lab users to identify equipment alternatives that are functionally equivalent from a user standpoint. Consider all domestic and foreign models available through US suppliers

The Labs21 equipment energy use form may be used to request data from manufacturers. (The form is available at http://www.labs21century.gov/toolkit/epc.htm.) Note that some manufacturers may require a Non-Disclosure Agreement (NDA) to provide these data.

ASHRAE Handbook of Fundamentals (2009) chapter 18 table 7 provides recommended heat gain from typical laboratory equipment and lists nameplate, peak and average watts for each type of equipment.

If energy use data is not available for comparison, use peak power rating for the equipment, taking into account all fuels that the equipment uses (not just electricity).

EA EPC Credit 2 **Right-size Laboratory Equipment Load**

Intent

"Right-size" mechanical equipment by improving estimates of heat-gain from laboratory and process equipment.

Requirements

Credit 2.1 (1 point): Measure base usage of equipment electrical loads in a comparable laboratory space for each functional type of laboratory space and design electrical and cooling systems based on these measurements.

A comparable laboratory space is one in which the equipment type, quantity and use profile is similar to the proposed laboratory space. For each comparable laboratory space, obtain one week (7 days) of continuous power metering at a distribution panel level of all laboratory equipment, including plug loads and hard-wired equipment, from a similar laboratory facility. The laboratory spaces for which the measured data is applicable should collectively constitute at least 75% of the net laboratory space. Metering data should be obtained while the spaces are fully occupied. Continuous metering data should be time averaged over 15 minute time periods. Design heat load criteria for each typical laboratory space in the facility should then be based on the maximum load indicated over the metering period, with no more than 50% added for a safety factor or for future changes in load, unless a reason for exceeding this limit can be justified.

Credit 2.2 (1 point): Design electrical distribution system to provide for portable or permanent check metering of laboratory equipment electric consumption. Design for safe access to electrical feeder enclosures and provide sufficient space to attach clamp-on or split core current transformers.

Develop a plan for metering laboratory equipment electric consumption and for adding the data to the Labs21 database. The plan for metering laboratory equipment electric consumption shall at a minimum include the following:

- Identify laboratory spaces and their panel-level metering points
- Metering specification for each panel using the Labs21 metering form or equivalent. (The form is available at http://www.labs21century.gov/toolkit/epc.htm.)

Strategies

Heat loads from laboratory equipment are often significantly overestimated leading to grossly oversized mechanical and electrical equipment. This results in higher first cost, and inefficient operation. Measured data should be used for estimating loads. Allowances for future growth should be taken judiciously. Designing the system so that additional capacity can be added in the future is recommended, and can be achieved through modular design of HVAC and electrical systems.

See the Labs21 Best Practice Guide on Right-sizing Laboratory Equipment Loads and the Labs21 Technical Bulletin on Measured Equipment Loads. Both are freely available at http://www.labs21century.gov/toolkit/bp_guide.htm

Materials & Resources

MR EPC Prerequisite 1 **Hazardous Material Handling**

Intent

Track and manage hazardous materials stream.

Requirement

Develop a system to maintain current information about hazardous material types, quantity, location, and disposal/use histories, and deliver information to a central location.

Strategies

Use Building Officials and Code Administrators (BOCA), International Building Code (IBC), or other generally accepted hazardous material classification tables to classify materials. Monitor all known hazardous materials quantities and locations on a continuous basis.

Provide an area for associated inventory tracking equipment.

MR EPC Credit 1 **Chemical Resource Management**

Intent

Reduce potential harm to the environment and people through improved management of chemicals.

Requirements

Develop an action plan to eliminate, minimize, substitute, recycle, and dispose of harmful chemicals safely. Plan should improve physical distribution, limit quantities, storage and waste, and develop a system to document improvements from standard practice on an on-going basis.

Strategies

Develop material handling and processing guidelines as a part of initial building design, and monitor implementation of guidelines as a part of final building commissioning. Guidelines should reduce consumption of hazardous materials, and to prevent potential contamination of the surrounding environment.

Provide dedicated centralized areas for receiving, return, or safe disposal of hazardous materials. Also provide dedicated space in each lab for receiving, return, or safe disposal of hazardous materials. Include an area for reporting of all hazardous material "transactions" to central inventory system.

Use "just in time" inventory and delivery system.

Work with Environmental Health and Safety (EHS) personnel and local code officials in developing action plan.

Use Green Chemistry practices. See:

- The MIT Green Chemical Alternatives Purchasing Wizard:
  http://web.mit.edu/environment/academic/purchasing.html
- EPA Green Chemistry Resources
  http://www.epa.gov/greenchemistry/pubs/tools.html
- Greener Education Materials for Chemists (University of Oregon)
  http://greenchem.uoregon.edu/gems.html
- Center for Green Chemistry and Green Engineering (Yale University)
  http://greenchemistry.yale.edu/
- WarnerBabcock Institute for Green Chemistry http://www.warnerbabcock.com/
- Sigma Aldrich: http://www.sigmaaldrich.com/chemistry/greener-alternatives.html

Indoor Environmental Quality

EQ EPC Prerequisite 1 **Laboratory Ventilation**

Intent

Ensure that minimum requirements for IAQ and safety are met.

Requirements

Meet the minimum requirements of ANSI/AIHA Z9.5 (latest version).

Strategies

Provide monitoring and control of fume hoods and room pressure. Technologies include fume hood monitors and alarms, volume metering and automated laboratory room pressure control. Use the explanations provided with ANSI Z9.5.

Protection and Notification Systems

Intent

Ensure health, safety, and awareness of employees.

Requirements

Design all alarm systems in the laboratory to be inherently self-identifying and failsafe. Alarms systems shall include but are not limited to: fume hood alarms, ventilation alarm, exterior door/window alarms.

Occupant notification device shall be incorporated into chemical fume hoods, when VAV (variable air volume) systems are installed, to measure the change of tempered exhaust volumes when the fume hood sash is raised or lowered.

Provide a notification system to laboratory occupants for all doors leading directly from pressure-controlled laboratory spaces to the outside.

Fume hoods and other equipment affected by cross-drafts must not be placed adjacent to exit doors except emergency-only exits, unless adequate precautious are in place to prevent fume hood operation with door open. “Adjacent to exit door” means 6 foot or less.

Definitions

Self-identifying means that the cause of the alarm is immediately clear to the occupants so that they can take appropriate action. Lighted signs, labeled signal lights or an annunciator are some ways to achieve this objective.

Failsafe is defined as an automatic function on an alarm that immediately notifies the occupants and building maintenance staff if an alarm becomes inoperative for any reason (e.g. component failure, burned-out or absent indicator light, vandalism). The "operating" and "trouble" indicators on a fire alarm system are an example. For practical purposes, the definition of failsafe should be extended to include systems that are easily tested by the user on a regular or "before use" basis.

A failure mode analysis is a comprehensive study of the ways a system may fail (e.g. broken circuit, non-functional detector and power failure) to assure that there is a fail-safe pathway for every type of failure.

EQ EPC Credit 1 **Laboratory Air Flow Analysis**

Intent

Ensure health and safety of laboratory occupants.

Requirements

Optimize indoor airflow based on results of computational fluid dynamics (CFD) or physical modeling.

Strategies

Optimize indoor lab airflow with proper fume hood location. Use small control zones. Use specialty laboratory supply air diffusers. Separate lab from non-lab spaces.

See the Labs21 Best Practice Guide on Optimizing Ventilation Rates. http://www.labs21century.gov/toolkit/bp_guide.htm

EQ EPC Credit 2 **Containment Device Commissioning**

Intent

Ensure health and safety of laboratory occupants.

Requirements

Conduct fume hood commissioning that includes ASHRAE-110 Method of Testing Performance of Laboratory Fume Hoods (latest version) *As Installed.* The following performance tests specified in the standard shall be witnessed:

- Airflow visualization
- Cross drafts velocity
- Exhaust flow measurements; at different sash configurations for VAV hoods
- Face velocity; at different sash configurations for VAV hoods
- VAV Response and Stability
- Hood static pressure measurement,
- Tracer gas containment tests. The hood performance rating for the Tracer Gas Test procedure shall be at least 4.0 AI 0.1 as specified in ANSI Z9.5.

Comply with the SEFA (Scientific Equipment and Furniture Association) 1.2 "As Installed" recommended practices for chemical fume hoods.

Biosafety cabinets must meet or exceed the requirements of, and be currently listed by, the NSF International Standard 49 (latest edition, current edition is 49-04a) as meeting the design and construction requirements of the standard. Cabinets must also be field tested and certified "as installed" to meet the performance requirements of the standard. Only biosafety cabinets that depend on exhaust to the outside to maintain performance need to be recertified under conditions of reduced air supply. Most biosafety cabinets do not depend on exhaust to the outside to maintain performance and only need to be certified under normal conditions.

For exhaust devices that do not have standardized test procedures (e.g. ventilated storage cabinets, snorkels, instrument exhausts), verify performance with smoke test or other appropriate method as described in the Labs21 Best Practice Guide on Exhaust Devices Commissioning.

If air supply and exhaust are reduced when the laboratory is unoccupied, all devices that exhaust air must meet containment requirements with normal and reduced air supply. This requirement applies to any case that varies the air supplied through a device without varying any operating parameters of the device (e.g. sash height, baffle position).

Strategies

Labs21 Best Practice Guide on Exhaust Devices Commissioning. http://www.labs21century.gov/toolkit/bp_guide.htm

The following sections of ANSI Z9.5 provide additional information on fume hood commissioning:

- Section 6.1 Performance specifications, tests, and instrumentation
- Section 6.3.4.2 VAV Hood Performance Tests.