Implementation Guide to the Berkeley Lab Sustainability Standards for New Construction

Revision date is indicated on the footer of the following pages

Table of Contents

1 Introduction

This document provides additional information designed to ease implementation of the Berkeley Lab Sustainability Standards for New Construction. Guidance is provided below for selected policy sections.

2 Design Team Selection and Contracting

2.1 RFP

Include the following text (adapted as needed) in the Request for Proposals (RFP) for the project architectural and engineering (A/E) team.

1. A/E Team should have relevant experience with cost effective environmentally sustainable design, as described in the Berkeley Lab Sustainability Standards for New Construction found at LBNL Requirements and Policy Manual. The Offeror should note in its SF 330 A-E Qualifications form any projects with exemplary energy or water performance, and/or that achieved certification at least a LEED™ Gold level, and should note all proposed Team members that participated. Performance exceeding ASHRAE 90.1 by a minimum of 30% would be considered exemplary.
2. A/E Team should have relevant experience using energy models to estimate as-operated energy performance and experience verifying modeled energy performance with measured performance post-occupancy. The Offeror should include in its SF 330 A-E Qualifications form recent relevant project experience involving the use of energy models that estimate energy performance relative energy performance design targets, and the as-operated energy use performance compared to the final design model, and should note all proposed Team members that participated.
3. A/E Team should have relevant experience with projects with low-energy mechanical designs appropriate for the mild climate of the LBNL site. The Offeror should include in its SF 330 A-E Qualifications form projects that deployed low-energy mechanical designs appropriate for the mild climate of the LBNL site, and should note all proposed Team members that participated.
4. A/E Team should have relevant experience in energy efficiency, pollution prevention, waste reduction, and the use of recovered and environmentally preferable materials, and other criteria at FAR 36.602-1. The Offeror should include in its SF 330 A-E Qualifications form projects that included design for energy efficiency, pollution prevention, waste reduction, and the use of recovered and environmentally preferable materials.

2.2 A/E Contract

Include the following text (adapted as needed) in the A/E contract:

1. The design shall meet the sustainability requirements as noted in the LBNL Sustainability Standards for New Construction found at LBNL Requirements and Policy Manual.
2. With the 50-percent-completed SD submittal, the A/E shall submit documentation, on appropriate California Energy Commission forms, certifying that the design complies with the code and CDDG. The A/E shall submit a complete performance approach computer simulation to meet Title 24 energy compliance for University review. Process loads shall be clearly identified

and implemented as allowed by California Code of Regulation Title 24, Part 6. The A/E shall correct any non-complying aspect of the design, including the energy compliance approach. Modeling runs shall also be run, and documentation submitted, to demonstrate energy performance target compliance with respect to ASHRAE 90.1 and "as operated" energy performance. A/E shall update all models in conformance with project scope as defined in the SD, DD, 50% CD, 90% CD, 100% CD, and as-built submittals.

3. A Commissioning Agent (CA) will be hired directly by the University. The CA will develop the commissioning specifications, coordinate the commissioning activities, review preliminary and final designs and report to the PM. The A/E team will become a member of the Commissioning Team. The A/E Team's responsibilities in commissioning will include, as applicable:
    a. Review the Commissioning Plan.
    b. Attend the commissioning planning and kick-off meetings and selected commissioning team meetings. The mechanical and electrical engineers should attend the controls integration meetings.
    c. Perform normal submittal review, construction observation, and O&M manual review. With the Trade Subcontractors and Commissioning Authority, actively assist in the development of the emergency power and fire alarm response matrix.
    d. Review the coordination drawings.
    e. Assist in clarifying the operation and control of commissioned equipment in areas where the Specifications, control Drawings, or equipment documentation is not sufficient for writing detailed testing procedures.
    f. Witness selected testing.
    g. Coordinate resolution of system deficiencies and warranty issues identified during commissioning.
    h. Provide an overview of system design and function during selected operator trainings.
    i. Provide design basis and design narratives documentation for the Systems Manual.
    j. Review Systems Manual.
    k. Warranty Period: Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning activities.
4. The A/E shall ensure that designs of new buildings and designs of alterations to existing buildings in which the space is heated or cooled comply with the California Code of Regulations, Title 24, Part 6, California Energy Code. Refer to the "Design for Energy Efficiency" section in part II of these guidelines for additional information. The University, acting as the enforcement agency, is required to independently check the designs and certify that they are in compliance with the code.
5. Provide, in an appendix listing documents provided by Berkeley Lab: Berkeley Lab Sustainability Standards for New Construction (from RPM, available here).

2 Energy Efficiency – Whole Building Performance Targets

2.1 Setting Targets

1. Targets are set as a percentage of baseline.
2. Projects should set a required design target and a more stringent, voluntary stretch target. The Lab's current practice is to set a design target at 50% of baseline and a stretch target at 35% of

baseline. This practice will be revised as warranted based on evaluation of as operated performance.

3. The baseline represents a building of similar use that has not not been significantly improved since approximately the year 2000, corrected to the Berkeley climate.
4. Default baselines are available at Sahai, R., Kniazewycz, C., Brown, K, 2014. Benchmark-based, Whole-Building Energy Performance Targets for UC Buildings. University of California Office of the President and California Institute of Energy and Environment.
5. Similar benchmark buildings at Berkeley Lab should be reviewed to refine default baselines. Choose at least 12 months of recent data from buildings of similar use type and configuration. Averages over longer periods can be used to help smooth out weather variations. Data gaps may be estimated if needed. Data may also be corrected to a typical year. Exclude buildings that have been renovated since the year 2000.
6. Significant atypical process loads may be excluded from the energy performance target, provided that that load is separately metered.

As well, the A/E team is encouraged to set system or end-use level targets to guide design. Here are some targets that Lab has used in the past in mixed laboratory and office buildings:

Level	**Metric**	**Design Target**	**Stretch Target**
Plant	Cooling Plant Average Annual Efficiency	0.4 kW/ton	0.3 kW/ton
System	Laboratory Ventilation Efficiency	0.75 W/cfm	0.5 W/cfm
System	Laboratory ACH	Optimized based on risk and ventilation effectiveness assessment	
System	Office Ventilation Efficiency	0.4 W/cfm	0.3 W/cfm
Building	Building Load Efficiency	550 sf/ton	750 sf/ton
Building	Whole Building Lighting Annual Energy	1 kWh/sf	0.5 kWh/sf
Building	Laboratory lighting Efficiency	0.75 W/sf	0.60 W/sf
Building	Office Lighting Efficiency	0.35 W/sf	0.30 W/sf

2.2 Verifying Targets

1. Design teams must prepare energy models to confirm compliance with targets. Models are to be developed beginning at schematic design or Critical Decision 2 (CD-2), updated with building program and material changes at end of design and end of construction administration, and represent the best estimate of as-operated building energy use and peak demands, before accounting for on-site energy generation.

2. The Lab does not stipulate the energy software to be used for modeling. Design teams are to use their professional judgment to best represent the as-operated building energy performance.

3 Energy Efficiency – ASHRAE 90.1 Compliance

The ASHRAE 90.1 performance requirement is incorporated into the Guiding Principles for Sustainable Federal Buildings, discussed further under Section 6. For Federal compliance, ASHRAE 90.1 energy performance may be calculated excluding receptacle and process loads. See guidance in §433.101 (4) in 10 CFR 433. Berkeley Lab requires compliance using standard, industry-accepted calculations that include receptacle and process loads. For receptacle and process load measures that are dependent on occupant behavior (not only building design), please scope the measures to enable Berkeley Lab to implement these measures in operations.

4 Energy Efficiency – Lighting Systems

The exterior lighting control system is Sylvania Encelium. Exterior luminaires shall be integrated into the sitewide exterior lighting control system where feasible, on either an individual luminaire or an electrical circuit basis. Where individual luminaires contain vacancy sensors or are rated at 40W nominal or above, individual fixture integration is preferred. Circuit integration is preferable for installation of luminaires for low-wattage luminaires or group-control of part-night scheduled luminaires.

The primary interior lighting control systems in use at Berkeley Lab are Wattstopper and Lutron Quantum. The Lab will provide specific direction on a system selection for basis of design on a case-by-case basis.

Berkeley Lab has not defined standard daylighting requirements as policy, but the following daylighting (and glare management) design targets are provided as starting points for the design team:

- Large Lobbies
  Achieve Spatial Daylight Autonomy at 300 lux for 75% of occupied hours (sDA300/75%) for 90% of the lobby space.
- High Bay Labs
  Achieve Spatial Daylight Autonomy at 300 lux for 50% of occupied hours (sDA300/50%) for 65% of the high bay function spaces.
- Collaboration, Private Offices, Meeting Rooms, and Collaboration / Open Office Areas
  Achieve Spatial Daylight Autonomy at 300 lux for 65% of occupied hours (sDA300/65%) for 80% of all standard work spaces. Through the facade and shading design, and/or the application of automated motorized shades, ensure that direct sun does not strike a work desk surface any time during the year.
- Lab Spaces
  Ensure every lab bench seat has access to a clear view of daylight. Through the facade and shading design, and/or the application of automated motorized shades, ensure that direct sun does not strike a lab bench work surface any time during the year.

5 Green Building - LEED

The design team should update the specification Section 018113 Sustainable Building Certifications referencing the specific LEED points that the project plans to pursue. In particular, the design team should list required submittals from the general contractor that are applicable to the project and current version of LEED. Below are links to relevant example :

- Example of complete specification Section 018113 for a new construction project
- Example of LEED checklist from specification Section 018113 for a new construction project
- Example of LEED product data sheet from specification Section 018113 for a new construction project

6 Green Building - Guiding Principles for Sustainable Federal Buildings

New construction projects at Berkeley Lab that are greater than 25,000 gross square feet must comply with the Guiding Principles for Sustainable Federal Buildings. Current requirements and associated instructions for the Guiding Principles for Sustainable Federal Buildings are available on the Federal Energy Management Program (FEMP) website for Sustainable Federal Buildings. Design team must provide the Guiding Principles checklist in Appendix A or Appendix B or a third-party system outlined in Appendix C of the "Guiding Principles for Sustainable Federal Buildings And Associated Instructions".

Many requirements overlap with LEED certification requirements but not all. For example, to comply with the Guiding Principles, new buildings at Berkeley Lab typically require compliance with the most current version of ASHRAE "Ventilation for Acceptable Indoor Air Quality" Standard 62.1 and ASHRAE 55 "Thermal Environmental Conditions for Human Occupancy" as specified by the Federal Management Regulation. The policy text will be updated to include information about the Guiding Principles for Sustainable Federal Buildings.

7 Waste Diversion

Construction waste diversion is to be calculated consistent withLEED guidance:

- Exclude excavated soil, land-clearing debris from calculations. Include materials destined for alternative daily cover (ADC) in the calculations as waste (not diversion). Include wood waste converted to fuel (bio-fuel) in the calculations; other types of waste-to-energy are not considered diversion for this credit."
- However, for projects that cannot meet credit requirements using reuse and recycling methods, waste-to-energy systems may be considered waste diversion if the European Commission Waste Framework Directive 2008/98/EC and Waste Incineration Directive 2000/76/EC are followed and Waste to Energy facilities meet applicable European Committee for Standardization (CEN) EN 303 standards.

8 Water - Landscaping and Vegetation Management

Landscaping choices should align with the Lab Vegetation Maintenance Guide and associated plant lists.

9 Metering and Metrics – Drawings and Specifications Requirements

9.1 Drawings

Meter schedules in the drawings should include columns for design minimum and maximums as well as meter minimum and maximums to ensure that meter selections, including substitutions, are appropriate for all expected flow ranges. This includes all disciplines and meter types (electricity, natural gas, water, and BTU meters).

- An example of an electricity submeter schedule is available here.
- Examples of plumbing water meter schedule and a plumbing natural gas meter schedule are available here.
- An example of a mechanical flow and BTU meter schedule is available here.

Construction drawings should include a Metering Points and Integration Map as well as a table of Performance Metrics. The metering points should include all meters, from all disciplines. The performance metrics table should include annual target values, such as average, peak, and or annual totals, as well as formulas and plaintext formulas to calculate the metrics, using the metering points defined in the metering points lists. Target values should be based on the as-operated building energy model or other estimates of as-operated conditions. Design teams should seek to design metering to minimize the complexity and cost of deriving performance metrics.

An example Metering Points and Integration Map is available here. An example Performance Metrics table is available here

9.2 Specifications

Berkeley Lab has developed a metering specification section to ensure that meters are installed, calibrated, validated, integrated, and confirmed with end-to-end checks during construction and prior to energization. The metering section, Section 013515 Meter Installation, Calibration, Validation, and Integration, is in the process of being added to Berkeley Lab's master specifications. The current version of this section is available here. This specification should be referenced as a note in all meter schedules in the drawings and should be cross-referenced by other specification sections that include metering, including but not limited to the following specification sections:

- 019113 - General Cx Requirements
- 221112 - Facility Plumbing Piping Specialties
- 230519 - Meters and Gages for HVAC Piping
- 262713.11 - Electrical Metering
- 261116 - Low Voltage Switchgear

10 Control Systems Implementation

10.1 Point Naming Convention

Berkeley Lab utilizes SkySpark, a data analytics platform, to monitor all building systems in one platform, including HVAC systems from building automation systems, metering data, and lighting systems.

ALC is Berkeley Lab's standard building automation system, and ALC points are typically integrated into SkySpark via BACnet. DisplayName is an important property in ALC, but it is not visible through BACnet. Only select ALC object properties are visible through BACnet, such as RefName and Description. A consistent RefName is required to properly identify and integrate ALC objects through BACnet.

In ALC, hardware input and output objects have built-in trend objects. All other object types, such as analog values or network inputs, do not. Trending these other object types requires separate trend objects to be added to the logic. The corresponding stand-alone trend objects typically have default RefNames such as "m123", and they must be renamed in the logic in order to be meaningful when seen through BACnet.

Point naming convention for ALC:

1. Hardware, Network or Display AI/AO/BI/BO/AV/BV
    a. DisplayName - The object should be named according to its purpose, with asset tags in parentheses. For example, use SF, RF, or EF instead of BL; CHW Pump or TW Pump instead of GP. Specific equipment numbers must be included if the logic controls several pieces of equipment, such as chillers and pumps. Otherwise, generic names are preferred to facilitate the maintenance of the logic, in particular for zone controls.

       For example:
       Instead of "GP-2 VFD", use "CHW Pump 2 VFD Speed (91-GP-02)"
       Instead of "Room 123 DAT" use "Discharge Air Temperature"

    b. RefName - This is the object name available through BACnet and it should match the DisplayName minus the asset tag, with minimal abbreviation as necessary to fit within the 40-character limit.

       For example:
       If DisplayName is "CHW Pump 2 VFD Speed (91-GP-02)"
       Then an acceptable RefName is "chw_pump_02_vfd_speed"

2. Stand-Alone Trend Objects
    a. DisplayName - Trend objects should be named the same as the object they are trending.

       For example:
       If a trend object is added to trend the value of a Supply Airflow Setpoint in a zone's terminal unit logic, the Display Name should be "Supply Airflow Setpoint"

b. RefName - The RefName of trend objects shall match the trended object's RefName with a "_tn" suffix. For hardware I/Os, this happens automatically because the trend object is built in. For stand-alone objects, the RefName must be modified in the logic.

   For example:
   When adding a trend log object to a network analog input with a RefName of "chw_pump_02_vfd_speed", the trend object's RefName shall be "chw_pump_02_vfd_speed_tn"

10.2 Time Schedules, Occupancy Sensors, and Temperature Setpoints

Zone-level equipment should be included in a Scheduling Group that is associated with the zone use (for example, Lab or Office). Schedules indicate the expected occupancy pattern for the zones, allowing for adaptive setpoint optimization to pre-start the equipment for warmup or cooldown prior to scheduled occupancy.

Three levels of zone temperature setpoints are used at Berkeley Lab:

1. Unoccupied setpoints (typically 55-82℉) are used when both the time schedule and occupancy sensors are off.
2. Standby setpoints (typically 66-76℉) are used when the time schedule is on but the occupancy sensors are off.
3. Occupied setpoints (typically 68-74℉) are used when either the:
    a. Time schedule is on and no occupancy sensor is installed, or
    b. Occupancy sensors are on.

Zone-level temperature setpoints can be adjusted by occupants via push buttons on the thermostat. Occupants are able to increase or decrease the setpoints by 2℉. The setpoint adjustments are cleared upon transition of the time schedule.

Thermostats have manual-override buttons that allow an occupant to force equipment into occupied mode for up to 3 hours. If a thermostat is used to override the schedule on a VAV system, it will cause the AHU to start regardless of the status of the time schedule.

1. In a non-Lab VAV air system (AHU turns off during unoccupied periods), this requires overriding adjacent zones into occupied (or standby) modes to allow for the minimum required airflow at the AHU.
2. In a Lab air system, the AHU is always on so the manual override push button will only affect the temperature setpoints of the associated zone.

Occupancy sensors are not used to enable an AHU when the zone schedule is off. Manual-override buttons are used instead, as described above. The occupancy sensor will adjust setpoints at the zone-level equipment, which may cause heat/cool/airflow requests to be sent to the AHU and prompt it to start if its request thresholds are exceeded. This is a separate mechanism, which typically occurs during the pre-occupancy warmup/cooldown period.

Occupancy sensors may be used to reduce airflow setpoints when the zone's occupancy sensor is off (zone is vacant). This may entail reduced air change rates in select Labs, or it could mean disabling airflow entirely in zones such as conference rooms.

10.3 Controls Equipment Accessibility

Airflow controls are critical to Laboratory Safety and require regular maintenance. For this reason it is necessary to ensure that the most critical components are installed in locations that will be accessible post-construction, and to install serviceable and replaceable components.

At Berkeley Lab we utilize thermal dispersion sensors for airflow measurements because they can be easily cleaned and/or replaced without disassembly of ductwork. Airflow sensors in exhaust air streams experience fouling that can significantly reduce the magnitude of their measurements and impact Lab pressurization controls. Exhaust airflow sensors must be installed in locations that will remain accessible even after furniture and equipment has been installed in the Labs. Ideally, the sensors will be placed at least several feet downstream of the VAV box to allow for unregulated exhaust taps (i.e. snorkels) to be added in the future, so that the airflow from these taps is accounted for in general exhaust measurements.