

## Building commissioning for new buildings

**B**uilding commissioning for new buildings is a quality-assurance process to verify and document that building systems function as designed and meet the operational needs of the building owner and building users. Commissioning pays for itself many times over through operating savings, improved staff performance, and by avoiding costly construction problems.

### What is building commissioning?

The Building Commissioning Association describes building commissioning as *“a quality-based process with documented confirmation that building systems are planned, designed, installed, tested, operated and maintained in compliance with the owner’s project requirements.”*

Although it is becoming more common for large or complicated buildings, building commissioning is not standard practice. It goes beyond standard testing, adjusting and balancing and beyond traditional inspections.

The key elements in building commissioning include:

- Thoroughly documenting system design intent, operating sequences and test procedures.
- Verifying system performance with extensive functional testing and measurement.
- Ensuring that building operations staff receives the training and resources they need on system operation and maintenance procedures.

### Why perform building commissioning?

Commissioned buildings are more likely to perform as intended and avoid operational problems. Poorly performing buildings inherently have high costs. During the construction phase, commissioning results in better communication, fewer change orders and avoided litigation. Other benefits include reduced operation and maintenance costs, lower energy costs (through improved energy efficiency) and satisfied building

occupants and tenants (through improved indoor air quality and thermal comfort).

Experience has shown that a building that is not commissioned will cost 8 to 20 percent more to operate than a commissioned building. A 2004 report showed that, on average, energy savings alone can pay back the cost of performing commissioning in 4.8 years. Additional savings from improved equipment lifetimes, reduced change-orders due to early problem detection, prevention of premature equipment breakdown by timely detection, reduced operation and maintenance costs and improved indoor environment combine to essentially offset the entire cost of new-building commissioning.

As buildings and systems have become more complex and occupant requirements have increased, the need for commissioning is even greater. Informed building owners recognize that a high performance building gives them a competitive advantage.

Also, state and municipal codes, such as the Washington State and Seattle Energy Codes for non-residential buildings, are beginning to require systems commissioning. However, many of these minimum requirements fall short of the level of commissioning recommended by many providers, and local jurisdictions often do not have the resources to fully enforce all code requirements. Building owners need to be sure that their facilities are adequately commissioned by a qualified provider in order to obtain the full benefits from the process.

**Building commissioning provides benefits such as a smoother construction process, reduced operation and maintenance costs, lower energy costs and satisfied building occupants and tenants.**

## How much does building commissioning cost?

The price of building commissioning varies depending on the size of the project, complexity of building systems, the systems to be commissioned, when commissioning begins and the level of detail the process requires. A good rule of thumb is between 2 to 4 percent of the construction cost of the systems being commissioned. In the 2004 study referenced in footnote 1, the median cost for new-building commissioning was \$1.00/square foot, or 0.6 percent of total construction costs.

Owners often say they cannot afford to pay for building commissioning, but a look at the potential costs of not commissioning tell another story. These costs can include schedule overruns, change orders, litigation costs, high vacancy levels, uncomfortable occupants, excessively long shakedown periods, costly post-occupancy corrections, inability to perform adequate operation and maintenance and high operation costs. These costs can far exceed the price paid for commissioning. Commissioning reduces the risk of incurring these costs.

## When should building commissioning start?

Ideally, building commissioning should begin early in the design phase of the project. This allows the commissioning provider to work with the design team and become familiar with the project goals and design intent as decisions are made. Incorporating commissioning into the development process helps to ensure success and avoid problems and additional work later in the project. Commissioning can occur in the construction process or after completion, but it is more difficult to document the design intent, identify design problems, develop testing plans and conduct tests. This can compromise the potential for success.

## Who should perform building commissioning?

Who actually performs commissioning depends on the owner and the project. Typically, the building owner hires an independent third-party commissioning provider or authority to perform commissioning.

Those involved in the building commissioning field generally believe the provider should work for the owner and should represent the owner's interest. However, there are several options. As commissioning becomes more popular, a greater number of firms are offering building commissioning as part of their services. These include construction managers, test and balance contractors, design engineers and mechanical contractors. The nature of the project will determine which option is best.

Trained and certified commissioning providers can be located through the Building Commissioning Association (see list of resources at the end of this fact sheet).

# What are the steps in a commissioning process?

**B**oth the extent of the commissioning process and the roles of those involved in the project can vary. A comprehensive process beginning in pre-design and running through post-occupancy is justified for large, complex projects. For smaller buildings, the process should be simpler, focusing on system balancing, simple functional tests of key systems and documentation. The commissioning process for the design phases and construction process is described below, with emphasis on the commissioning provider's roles.

## Pre-design

The CP, working with the owner, establishes the parameters and expectations for the commissioning process. The CP may have limited input and review in this phase.

## Design

The CP outlines the scope of design requirements and design intent, describes the systems to be installed, outlines the documentation requirements for each party involved in the commissioning process, defines subsequent commissioning procedures and documents the process. This includes review to identify design issues and developing a commissioning specification that describes the contractor's roles and responsibilities in the commissioning process.

## Construction

The CP completes the commissioning plan at the beginning of the construction phase, obtains project schedules and develops a commissioning project schedule. The CP gathers and reviews the contractor submittals and operation and maintenance manuals. The CP writes detailed functional performance test plans for each system and piece of equipment involved in the commissioning process.

The CP visits the site to observe construction, notes details that might affect equipment and system performance or operation and coordinates with the various contractors to perform the pre-functional performance tests. The CP oversees all start-up tests and ensures that the pre-functional performance tests and checklists are completed and all deficiencies resolved.

## Acceptance

Using the functional performance test plans, the CP observes and verifies the proper operation of equipment, systems and controls per contract documents; verifies that corrective measures are taken; and ensures that completed operation and maintenance manuals are available. The various contractors usually carry out the actual performance testing. The CP oversees this process and may be actively involved. Shortly after the functional performance test is complete, the CP finishes the draft commissioning report, including all documentation, and submits it to the owner.

Training the building operation staff generally occurs near the end of the acceptance phase or shortly after building occupancy. It can be performed prior to, or as part of, the functional performance testing. This provides an opportunity for hands-on experience that can reinforce the training. Installation contractors, designers and manufacturers' representatives should do the training, and may include the CP. The CP should be involved in establishing the training needs of the building O&M staff and ensuring those needs are met.

## Post-Acceptance

Building O&M staff ensures that the facility's systems function properly, adapt the systems to changing occupancy and use, maintain a facility history and document all changes. The CP can be involved in establishing the documentation methods for this phase and can review performance and recommend improvements. The CP may also be involved in conducting seasonal performance testing that could not be done when the building was completed. Results from the post-acceptance phase are added to the commissioning report. The tools and resources developed during the commissioning process provide the basis for ongoing performance monitoring by building O&M staff to ensure that the benefits of commissioning are maintained.

# Where can I get more information about building commissioning?

The following resources provide more information on building commissioning for new commercial buildings.

## Programs and Organizations

U.S. Department of Energy Building Technologies Program – Determine Commissioning Requirements and Plan; includes a link to Model Commissioning Plan & Guide Specifications.

<http://www.eere.energy.gov/buildings/info/design/wholebuilding/determine.html>

U.S. Department of Energy Building Technologies Program – Building Commissioning Toolbox; includes a Commissioning Activities and Documentation Checklist. <http://www.eere.energy.gov/buildings/info/operate/buildingcommissioning.html>

U.S. Department of Energy Building Technologies Program – Commissioning Research and Development; includes links to diagnostics tools and software. <http://www.eere.energy.gov/buildings/tech/commissioning/>

Building Commissioning Association – BCA promotes building commissioning practices that maintain high professional standards and fulfill building owners' expectations; includes White Paper on Commissioning, February 2005. <http://www.bcx.org>

Portland Energy Conservation, Inc. PECE Resource Library – Access to commissioning documents and links to other information resources. <http://www.peci.org/library.htm>

The National Conference on Building Commissioning – An annual forum of owners, contractors, designers and commissioning professionals dedicated to furthering the practices of building commissioning. <http://www.peci.org/ncbc/index.htm>

National Clearinghouse for Educational Facilities – Created in 1997 by the U.S. Department of Education; a free public service that provides information on K-12 school planning, design, financing, construction, operations and maintenance.

<http://www.edfacilities.org/rl/commissioning.cfm>

U.S. General Services Administration Commissioning Program – Provides resources including a guide for building commissioning.

<http://www.gsa.gov/Portal/gsa/ep/channelView.do?pageTypeId=8195&channelPage=%2Fep%2Fchannel%2FgsaOverview.jsp&channelId=-15374>

## Documents

Commissioning Activities and Documentation Checklist

<http://www.eere.energy.gov/buildings/info/operate/commissioningchecklist.html>

U.S. Department of Energy, FEMP – Continuous Commissioning Guidebook

[http://www.eere.energy.gov/femp/operations\\_maintenance/commissioning\\_guidebook.cfm](http://www.eere.energy.gov/femp/operations_maintenance/commissioning_guidebook.cfm)

Commissioning and Monitoring for New Construction [http://buildings.lbl.gov/hpcbs/Element\\_5/02\\_E5\\_P2\\_1.html](http://buildings.lbl.gov/hpcbs/Element_5/02_E5_P2_1.html)

Diagnostics for Building Commissioning and Operation <http://imds.lbl.gov/>

Commissioning for Better Buildings in Oregon (pdf file 391 kB) – A comprehensive 44-page introduction to building commissioning.

<http://www.energy.state.or.us/bus/comm/commintr.pdf>

*The Cost-Effectiveness of Commercial-Buildings Commissioning: A Meta-Analysis of Energy and Non-Energy Impacts in Existing Buildings and New Construction in the United States*, Report Number 56637; Lawrence Berkeley National Laboratory, Portland Energy Conservation, Inc., Texas A&M University Energy Systems Laboratory, December 2004. <http://eetd.lbl.gov/emills/PUBS/Cx-Costs-Benefits.html>

Energy User News Fundamentals Series – “Understanding the Commissioning Process”

[http://www.energyusernews.com/CDA/Article\\_Information/Fundamentals\\_Item/0,2637,27467,00.html](http://www.energyusernews.com/CDA/Article_Information/Fundamentals_Item/0,2637,27467,00.html)

Additional resources can be found on Western's Energy Solutions database at <http://www.wapa.gov/es/>

## Technical Assistance

If you are a commercial or industrial customer in Western Area Power Administration's service territory, you can call the Energy Services Clearinghouse with your specific questions about building commissioning or other energy efficiency issues.



**Energy Services Web site**  
[www.wapa.gov/es](http://www.wapa.gov/es)

**Western's Power Line:**  
1-800-POWERLN  
(1-800-769-3756)

This fact sheet is published by Western Area Power Administration for its power customers. Contact us at: Western Area Power Administration, PO Box 281213, Lakewood, CO 80228-8213  
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