

SECTION 4-12: FACILITIES COMMISSIONING

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4-12-00 POLICY

This section addresses commissioning at existing facilities. See Volume I, Section 3-10 of this Manual for information related to initial commissioning for major renovation and construction projects. As required by the Energy Independence and Security Act of 2007 (EISA 2007), federal agencies must conduct a comprehensive energy and water evaluation for approximately 25 percent of their facilities each calendar year so that all facilities are addressed in four years.

EISA 2007, paragraph (3) of subsection (f) of the statute (42 U.S.C. 8253(f)(3)) states that “. . . energy managers shall complete, for each calendar year, a comprehensive energy and water evaluation for approximately 25 percent of the [covered] facilities of each agency. . . in a manner that ensures that an evaluation of each such facility is completed at least once every 4 years.” (42 U.S.C. 8253(f)(3)(A)) Further, “[a]s part of the evaluation. . ., the energy manager shall identify and assess recommissioning measures (or, if the facility has never been commissioned, retrocommissioning measures) for each such facility.” (42 U.S.C. 8253(f)(3)(B))

In conjunction with these evaluations, agencies are required to identify and assess re-commissioning or retro-commissioning measures for facilities evaluated.

- Commissioning is the systematic process of ensuring facilities systems are performing properly in accordance with design intent and the needs of the user. The commissioning process occurs during design and construction of a facility and ends typically at the end of the warranty period one year after the date of completion.
- Re-commissioning is the process of commissioning a facility or system after the project development and warranty phases of the facility or system. It is to ensure optimum performance of the facility, in accordance with design or current operating needs, over the useful life of the facility, while meeting building occupancy requirements. Re-commissioning has been proven to increase energy efficiency between 5 and 15 percent. Many of the efficiency measures identified through re-commissioning have simple payback periods from six months to two years because of the relatively low cost of implementation.
- Retro-commissioning is the commissioning of facilities that were not commissioned during their construction.
- Continuous Commissioning ensures continuous building systems optimization. Continuous Commissioning maintains long-term savings using ongoing monitoring of energy consumption with follow-up commissioning, as needed. It also improves system

reliability and building comfort by optimizing system operation and control schedules based on actual building conditions, upgrades the operating staff's skills by allowing direct participation in the process, and reduces O&M costs.

The full text version of the EISA Section 432 DOE energy management guidelines including facility audit and commissioning guidance can be found at:

http://www1.eere.energy.gov/femp/pdfs/eisa_s432_guidelines.pdf

4-12-10 PROCEDURES

OPDIVs shall identify and assess re-commissioning and retro-commissioning measures as part of the energy and water evaluation process required by EISA. The schedule for assessing facilities shall be established based upon knowledge of the existing buildings and their operational conditions. Priority shall be given to facilities with histories of high energy use and / or excessive service calls.

OPDIVS should draw from their own technical expertise, knowledge of each facility and industry standards available to develop their re/retro-commissioning and continuous commissioning process. This document is general in nature and not to be considered a manual to develop a facilities commissioning process.

A. Initial Assessment

Facility energy managers shall perform an Initial Assessment to determine if the facility is a good candidate for a more detailed assessment. Energy managers shall conduct a walk-through of the facility to:

- review equipment information
- review design documentation
- review service call history
- evaluate O&M practices
- spot check several pieces of equipment

This evaluation can take from 4 to 8 hours for a typical office building. If the initial walk-through finds that the building does not require more a detailed commissioning effort (i.e., all equipment is operating according to specifications and any identified minor remedial actions are addressed), then the commissioning requirement for the building is fulfilled. Results and findings of the Initial Assessment shall be documented.

B. Detailed Re/Retro-commissioning Evaluation.

A Detailed Re/Retro-commissioning Evaluation shall be conducted on buildings identified during the Initial Assessment as economically viable candidates for further commissioning. Detailed commissioning efforts can take from 1 to 4 days, depending on the size of the facility. Re/Retro-commissioning will identify energy and /water-related O&M optimization opportunities and their related estimated savings and implementation costs. More capital-intensive retrofit opportunities should be identified and included in the detailed audit portion of the comprehensive energy and water evaluation.

The Detailed Re/Retro-commissioning Evaluation can be performed by in-house facility personnel or an independent commissioning agent. In most cases, in-house staff and the Energy Manager make an effective commissioning team. Their knowledge of the building and its equipment help expedite the process and reduce the cost of the evaluation.

The Detailed Re/Retro-commissioning Evaluation must include a report summarizing the findings and recommendations of the evaluation as outlined in the DOE “Commissioning for Federal Facilities” guide. This report will be used by facility energy managers to prioritize the implementation of efficiency measures so that low or no-cost measures can be implemented immediately. The performance of the evaluation and a summary of the findings should be included in the OPDIV annual energy report.

C. After the initial commissioning of a facility has been completed, O&M staff should conduct ongoing commissioning activities and reviews of their facilities by implementing a continuous commissioning program. A continuous commissioning program enables staff to continuously monitor building systems, so that problems can be identified and resolved before they become larger issues. While other forms of commissioning focus on bringing building operation to the original design intent, continuous commissioning focuses on optimizing HVAC system operation and control for the existing building conditions. Based on results from one study of more than 130 buildings, the average measured utility savings were about 20%, with simple paybacks often in less than two years.

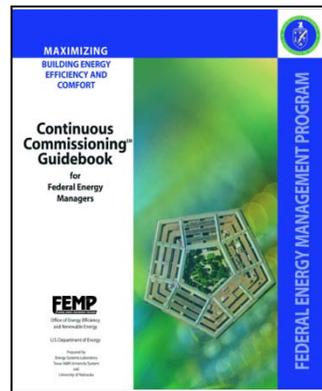
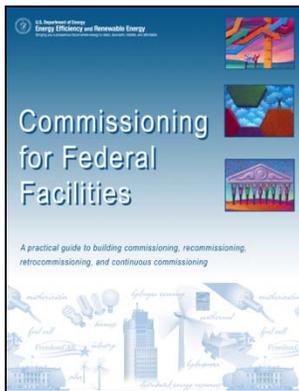
4-12-20 GUIDANCE AND INFORMATION

The following table from the Commissioning for Federal Facilities Guide provides information on performing different types of commissioning:

Type of Commissioning	Why?	Who?	When?	How?
Commissioning	Ensure that the building and its systems and equipment operate as designed	Independent CxA hired by the Owner or the project Construction Manager	Once, during new construction or renovation	Verification and functional performance testing
Retrocommissioning	Identify and correct problems and optimize performance	Facility O&M staff or independent CxA	Once, in response to specific problems or to establish a commissioning program	Diagnostic monitoring and functional performance testing
Recommissioning	Ensure that the building and its systems and equipment continue to operate as designed, or meet current operating needs	Facility O&M staff or independent CxA	Periodically as the building ages, or ongoing as part of the facility O&M program	Functional performance testing
Continuous Commissioning	Identify and correct problems and optimize performance	Facility O&M staff or independent CxA	Ongoing as part of the facility O&M program	Data monitoring and trending

SM
1 The terms Continuous CommissioningSM and CCSM have been service marked by the Texas Engineering Experiment Station Energy Systems Laboratory to ensure a consistent meaning for this terminology, as described in this guidebook.

The Department of Energy, Federal Energy Management Program (FEMP) has developed two documents that provide detail on the commissioning process. These documents outline how to decide what type of commissioning is needed for a facility, who should perform the commissioning, how to choose a commissioning agent, if necessary, and what to look for during the evaluation. The documents are “Commissioning for Federal Facilities” and the “Continuous Commissioning Guidebook for Federal Energy Managers.” They can be found at http://www1.eere.energy.gov/femp/pdfs/commissioning_fed_facilities.pdf and http://www1.eere.energy.gov/femp/program/om_guidebook.html.



The DOE “Commissioning for Federal Facilities” guide provides an outline for a comprehensive retro-commissioning plan.

Another tool that is available to assist with in-house evaluations and provide guidance to commissioning agents is the FEMP Energy Savings Expert Team (ESET) checklist. This checklist was developed to assist auditors identify energy savings. This checklist is recommended by FEMP as a model for commissioning efforts and can be found on the FEMP website at http://www1.eere.energy.gov/femp/docs/eset_checklist.xls. It is important to note that the checklist was developed to identify energy savings related to heating systems. It does not address all building systems. However, it does outline the types of issues to look for and questions to ask.

The DOE also offers on line training which provides an interactive guide to the “Commissioning for Federal Facilities” booklet. The online training covers ongoing commissioning processes to resolve operating problems, improve comfort, optimize energy use, and identify retrofits for commercial and institutional buildings and central plant facilities. It provides specific information and actions to achieve operations and maintenance savings and benefits, including an overview of commissioning, re-commissioning, and retro-commissioning. This training can be found at the following link:

http://apps1.eere.energy.gov/femp/training/course_detail_ondemand.cfm/CourseId=3

In addition to the DOE guides and checklist, other valuable resources are available to assist you in commissioning your facility. The Portland Energy Conservation, Inc. (PECI) offers on-line commissioning and technical resources at <http://www.peci.org/resources/commissioning.html> and <http://eber.ed.ornl.gov/CommercialProducts/RetroCx.htm> and <http://www.cacx.org/>. The website has extensive commissioning information such as a retro-commissioning toolkit, spreadsheet tools and templates, documents from the California Commissioning Collaborative (CCC), as well as CCC commissioning guides for new and existing buildings.

The New York State Energy Research and Development Authority (NYSERDA) has sample documents on-line to streamline the commissioning process. These documents include example commissioning plans, functional tests and reports and can be found at the following link: <http://www.nyserda.org/programs/Commissioning/default.asp>. In addition, ASHRAE Guideline 0-2005, “The Commissioning Process”, the industry –accepted Commissioning Guidelines can be purchased at http://www.techstreet.com/cgi-bin/detail?product_id=1619765. Also NEBB National Environmental Balancing Bureau standards for building retro-commissioning and commissioning can be found at: <http://www.nebb.org/neb/proceduralstandardin.php>

A sample re/retro-commissioning scope of work can be found at:

http://www1.eere.energy.gov/femp/pdfs/11_3_exampleretocommissioningsow.pdf

The document was developed by FEMP for use with Super Energy Savings Performance Contracts, but may be modified to fit the OPDIVs’ needs.

Additional information on the functions and responsibility of the Commissioning Agent can be found in Volume I Section 3-10.

A sample of a commissioning “Lite” Scope of Work included as Appendix A can be used when comprehensive commissioning is not necessary or too costly. This document was developed by GSA and may be modified to fit the OPDIVs’ needs.

4-12-30 REPORTING REQUIREMENTS

In order to track progress toward the goals of the HHS Sustainable Buildings Policy, OPDIVS are required to report commissioning efforts and progress annually in accordance with EISA 2007 on the annual energy and water efficiency report.

Appendix A: Sample Commissioning “Lite” Scope of Work

SCOPE OF WORK RETRO-COMMISSIONING LITE

[Project Title and Address]

[Date]

PURPOSE

Retro-commissioning Lite applies a systematic investigation process for improving and optimizing a building’s operation with respect to the energy management control of most of the HVAC components. It may or may not emphasize bringing the building back to its original intended design. In fact, the original design sequence of operations may be adequate but there are generally opportunities to improve on them. Retro-commissioning ensures system functionality. Recommendations shall be made to investigate further capital improvements but it is the operation tune-up activities and diagnostic testing that is the function of this scope and will be used to optimize the building systems. The Retro-commissioning process will focus on the dynamic energy-using systems with the goal of reducing energy waste, obtaining energy cost savings for the owner, and identifying and fixing existing problems.

For purposes of this evaluation the Retro-commission team shall consist of:

- Maintenance Contractor
- Controls Contractor
- Testing and Balance Contractor
- Mechanical Engineer with extensive controls experience

The project team leader will be the Mechanical Engineer since it will be his responsibility to coordinate the team efforts, assign tasks, and identify control modifications / enhancements and record changes. This project consists of approximately three intensive weeks (120 hrs) of on-site commissioning. It is not the intent of the project to solve all issues but to provide a more efficient system and allow the maintenance contractor to obtain better understanding of relationships between the engineers design intent and the control system execution of the sequence of operation.

TYPICAL RETRO-COMMISSIONING PHASE TASKS

The retro-commissioning process can be viewed as consisting of four primary phases:

1. Planning phase

Mechanical Engineer shall:

- Review available documentation

- Develop retro-commissioning plan

2. Investigation phase

All team members shall:

- Perform site walk thru
- On site meeting with the Building manager and their technical advisors
- Obtain or develop missing documentation as practical
- Develop and execute diagnostic monitoring and testing
- Develop and execute functional test
- Measure and Record chilled and heating water flows
- Measure and Record supply, return and outside air flow for various troublesome air handling units and as time dictates gather additional TAB data as directed by the engineer, owner or as suggested by the TAB engineer
- Perform trial and error solutions and analyze results
- Develop Master List of deficiencies and any improvements performed as part of this work
- Recommend most cost-effective improvements for implementation

3. Implementation phase

- Implement repairs and improvements as practical during the course of this work
- Retest and re-monitor for results
- Fine-tune improvements as needed
- (Optional) Develop a list of future work items that should be performed to further optimize the systems. This shall include a cost estimate for the work and calculations of the anticipated annual energy savings and the simple payback

4. Project hand-off and integration phase

- Prepare and submit final report. The mechanical engineer shall gather all data to incorporate into his final report. Provide 6 copies for review with photographs as necessary in support of the report.

An overview of the specific tasks is requested for this cost proposal. The specific tasks recommended for this project have been highlighted below.

After reviewing the building documentation package and gaining a clear understanding of the project objectives, the Mechanical Engineer has the primary responsibility for developing the plan.

The plan will include the following information:

- Preliminary review of the documentation
- Commissioning Plan and Objectives
- Scope of Commissioning
- Commissioning team members and their roles and responsibilities

- Description of diagnostic monitoring and use of energy management control system trending

Preliminary review of the documentation

Provide review and comments/questions in order to be better prepared for the three weeks of onsite work. The maintenance contractor shall provide four weeks of data trending (including weekend operation) for review by the mechanical engineer prior to the onsite effort.

Commission Plan and Objectives

The scoping meeting brings all of the team members together to review, discuss, and agree to the retro-commissioning plan. The goal of the meeting and site assessment is to gain an understanding of how the building systems and equipment are currently operated, why they are operated in that way, and what building staff and occupants consider to be the most significant problems.

Scope of Commissioning

It is not the intent for the commissioning team to test all systems from the air handler to the final diffuser or the flow rate to every fan coil or VAV Reheat coil (unless time permits and the number of systems are not excessive). The purpose of the commissioning is to greatly improve the system operation by determining whether or not the system is operating as designed or its operation has been tweaked by the maintenance contractor which in itself may have consequences not fully understood by those involved. Once an understanding of the system is developed the team shall incorporate and document the control and operation changes.

Commission Team Members

Mechanical Engineer – This individual shall be responsible for working with the team to ensure that trending is being measured, reviewed, tested and/or captured at all times. This trending, measuring, testing, and recording shall be performed during the entire three week period and consolidated for inclusion into the final report. The engineer shall direct the Owner's maintenance staff in the implementation of minor O&M recommendations as part of the ongoing system adjustment. Conduct overall system level training of maintenance staff to communicate the design intent, theory of system operation, delineate the function of individual components in the system, and intersystem functional operations.

Control Contractor – The individual shall have the knowledge and ability to analyze and program the existing system so that the latest in energy strategies can be put into operation. The modifications shall be based on their knowledge of the system and the mechanical engineers sequences. It is vital that the person working on this project be very familiar with the current Direct Digital Control (DDC) front.

Testing and Balance (TAB) Engineer – This individual will be responsible for gathering existing information, troubleshooting balance issues and making recommendations which will be

incorporated during the course of this project. Any existing test and balance (TAB) reports shall be compared by checking system readings for the mechanical equipment.

Maintenance Contractor – The maintenance group responsible for the building shall work closely with the team. They will perform the work necessary to ensure that the systems are functioning properly.

SUBMITTALS

1. Preliminary Review of the Report with comment/questions and responses
2. List of Deficiencies found and corrective measures performed
3. Final Report including potential Energy Efficiency Capital Improvements

SYSTEM DESCRIPTIONS

[Brief description of facility.] The following table lists the specific systems and sub system items identified for retro-commissioning activities (if known). Additional information about the systems will be provided during the planning phase activities. Notes at the bottom of the table provide additional information relevant to specific items.

NOTE: List specific equipment below to be included in the Retro-Commissioning effort

Systems and Major Items	Included in Scope of Work?	Notes
Mechanical Equipment		5
Air Handling Units	Yes	1, 3
Terminal Units	Yes	1
Central Plant Heating Equipment (Includes boilers, pumps, piping systems)	Yes	1
Unit Heaters	No	
Central Plant Cooling Equipment (Includes chillers, pumps, cooling tower)	Yes	
Exhaust Fans	Yes	
HVAC Controls	Yes	2

Note 1: HVAC systems (AHUs, heating and cooling) will be reviewed under one system wide test during the investigation phase.

Note 2: Controls system operation will be primarily verified through data trending using the existing controls front end system. If necessary, functional testing would occur during investigation phase to examine specific issues of concern.

Note 3: Electrical testing services for emergency power, grounding or power quality are not currently included as part of the initial scope of work.

Note 5: Mechanical systems not included in commissioning activities include ductwork, fire and smoke dampers, equipment sound and equipment vibration measurements.

Note 6: Electrical systems not included in scope of work include (day) lighting controls, power quality, security systems, UPS, fire and smoke alarms, fire protection, communications, and public address/paging systems.

Note 7: Miscellaneous systems not included in scope of work include plumbing systems, service hot water, refrigeration systems, and vacuum systems.