

Sample - Existing Building Commissioning Plan

Version: Draft for Review

Final Approved: _____

Owner

Date

Site Address:

Primary Site Contact Name and Telephone Number:

Building Description

The site consists of five buildings, of which some are connected. Most are two story, with Buildings 3 and 5 being 2-story. Buildings 2, 3 and 5 will be analyzed in this project. Building 2 is 38 years old, 30,500 sf 1-story of 100% office space. The HVAC system consists of 6-15 ton DX bypass VAV units with hot water reheat and with DDC to the terminal units, though the reheat is controlled by pneumatic thermostats. The DX equipment was replaced in 1992. The heating water is supplied by 2-175 hp boilers in this building which also serve buildings 1, 3; 4.

Building 3 is 30 years old, 67,500 sf, 2-story ~70% office and ~30% lab (product formulation, light bench electronics work, no fume hoods). It is serviced by 17-15 to 30 ton DX, no VAV, constant volume with reheat and perimeter baseboard. Most of the system is DDC. Equipment was replaced in 1992. The heating water is supplied by 2-175 hp boilers in B-2 which also serve buildings 1, 2; 4.

Building 5 is 13 years old, 132,400 sf, 2-story, 90% office. It is served by 6-20 to 40 ton VAV air handlers with reheat. Chilled water is provided to B-5 and B-1 from a 500 ton and a 400 ton chiller, which has a plate and frame heat exchanger for water-side economizing. The chiller system will not be evaluated in this project, unless time permits after assessing the other systems. There are 13 variable speed drives in the building. The heating water is supplied by a 200 hp boiler in the building.

The controls system is a Landis/Staefa System 600. There are pneumatic actuators and the majority of points are DDC. There are about 2900 sensed points, 350 actuator points and 250 digital outputs.

Lighting control is provided by a GE control package.

Commissioning Objectives

The following have been identified by the owner as the primary objectives of this retro-commissioning project, in order of importance:

- Pilot demonstration for replication
- Reduce energy and demand costs
- Bring equipment to its proper operational state

Retro-Commissioning Scope

This project will observe the building's present operation and maintenance strategies and practices in an attempt to find cost effective improvements that can be implemented primarily by the owner's building staff and service contractors. It does not include extensively investigating or implementing capital

improvements. However, in the course of the assessment, any energy efficient capital improvements that are thought to be effective, will be offered as recommendations to the owner.

This project will focus on the operation side of O&M, with attention being paid primarily to maintenance issues that will significantly impact indoor environmental quality, operability of the building or energy consumption.

All equipment listed below will be initially investigated. However, from the information gathered in the initial site assessment (before actual functional testing or monitoring), the investigation may focus-in on specific equipment and may not further investigate some equipment listed below,

The following tasks are included in the scope of this project and apply to all equipment listed below, unless specifically noted otherwise:

1. *Selectively* investigate for operational improvements and selectively determine the sequences of operation for equipment listed below in order to most *efficiently* identify operational improvements (i.e., after some investigation if equipment appears to be functioning properly, further investigating and documenting sequences will not be done). Document improvements made to current sequences of operation.
2. Through monitoring and functional testing, verify and document whether the systems are functioning according to the identified sequences of operation, not including alarms and safeties.
3. Methods used for the above two tasks include:
 - examination of control drawings and written sequences
 - examination of control program code
 - interviewing of facility staff
 - installing portable dataloggers and analyzing data
 - initiating BAS trend logs and analyzing data
4. In the normal course of the operational assessment, document equipment conditions that need attention.
5. Determine any needed additional facility staff training.
6. Write system description narratives for each system investigated.

The following marked systems will be commissioned in this project and represent the selected equipment and systems referenced above.

HVAC System (and all integral equipment controls)

- Chiller system (including controls, chillers, cooling towers, piping, pumps and variable speed drives)—This will be evaluated if time permits.
- Boiler and steam or heating water system (including controls, boilers, piping, pumps and variable speed drives)
- Pumps
- Variable speed drives
- Heat exchangers
- Piping: valves, ___cleaning and flushing
- ___ Chemical treatment
- ___ Ductwork

- Air handling units
- Unitary heating and cooling units
- Exhaust systems (other than smoke control)
- Roof top packaged DX units (heatpumps or AC)
- Computer room A/C units
- Split systems
- Evaporative coolers
- Evaporative condensers
- Terminal units: all, limited to a sampling
- Testing, Adjusting and Balancing work in: all areas, only in the following areas _____

Air distribution to spaces (limited to known problem areas _____)

- Unit heaters
 - Building automation system (controlled devices, control loops and system integration)
 - Indoor air quality (explain). IAQ will only be evaluated as issues are identified in the normal course of our assessment.
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Electrical Systems

- Sweep and scheduled lighting controls
- Daylighting/dimming controls
- Electrical system power quality
- Communications system
- Security system
- Emergency power systems
- Uninterruptible power supply system

Life Safety Systems

- Fire alarm system
- Egress pressurization systems
- Fire suppression/protection systems

Plumbing

- Domestic booster pump
- Domestic hot water heaters

Laboratories/ Clinics

- Fume hoods
- Room isolation
- Room pressure differentials
- Process gas _____

Misc.

- Elevator
- Kitchen exhaust equipment

Water Management

- Evaluate HVAC and domestic water use, via:
 - Facility staff interview and visual inspection
 - Fixture study and flow verification
- Evaluate irrigation water use
 - Facility staff interview and general inspection
 - Measurement of use vs. need
- Develop a written water management plan

Waste Management

- Evaluate solid waste management practices and benefits
- Develop a written solid waste management plan

Other (list)

Roles and Responsibilities

The following table lists the members of the commissioning team:

Commissioning Team

Name and Firm	Title or Role	Voice / Pager	Fax / Email	Address
	Energy Engineer			
	Site Manager			
	Maintenance Manager			
	HVAC Foremen			
	Site Engineer— Electrical			
	Utility Representative			
	Commissioning Provider			

The individual responsibilities of each team member are:

Energy Engineer

1. Provides supervision of this project relative to the energy issues and the owner's interests
2. Attends meetings as necessary
3. Approves the choice of improvements to implement
4. Assists in the assessment as time permits

Site Manager

1. Is the party referred to as the "owner"
2. Ensures the participation of building personnel and service contractors as needed
3. Provides input into the assessment (via interviews)
4. Directs and oversees the implementation of improvements and the gathering of documentation
5. Attends meetings as necessary
6. Works with facility staff in management of assignments so that operator can assist in the assessment and commissioning process
7. Approves the choice of improvements to implement

Building Maintenance Manager and Technical Staff

1. Assists in gathering the building documentation
2. Provides input into the site assessment (via interviews)
3. Executes and documents the needed system calibrations
4. Assists with the installation and removal of diagnostic equipment
5. Executes requesting BAS trend logs
6. Executes manual functional tests
7. Implements the identified O&M improvements
8. Attends meetings, as necessary

Commissioning Provider

1. Is the technical lead for this project
2. Develops the assessment plan
3. Develops and conducts the scoping meeting
4. Holds other meetings as necessary
5. Provides calibration forms and reviews completed forms
6. Gathers and reviews documentation
7. Administers the operations initial site assessment (interviews, inspections and analysis)
8. Oversees the monitoring diagnostic plan and execution
9. Oversees the manual functional testing plan and execution
10. Keeps a master improvement list
11. Oversees the energy calculations
12. Works with the facility manager to see that the improvements are implemented and verified
13. Writes the final report.

Management Protocols

The Commissioning Provider is under contract with the (**Utility**), whose objective is to serve their client, (**Name of site owner**). On site, the Provider will report to the Maintenance Manager. All reports from the Provider will go to the Maintenance Manager, the Energy Engineer and to (**the utility**). The Maintenance Manager will forward a copy to the Site Manager.

The commissioning provider will set and adjust schedules with the affected parties directly and inform all other team members of the schedules.

Authorization for making changes to controls sequences, schedules and escort requirements are identified on Form B-6, *Authorization Protocols for Building Assessment*, in Appendix B.

Retro-Commissioning Process

Documentation

The commissioning process begins with the gathering and review of various building documentation.

Form B-2, *Request for Documentation and Record of Submissions*, previously sent to The owner's staff, contains a list of documentation needed for this project. The documentation not yet provided is noted on this form and will need to be made available to the Commissioning Provider at the initial site assessment.

From the reviewed documentation and initial walk-through, the commissioning provider developed this overall commissioning plan. The plan for this project has been divided into the following primary steps:

1. Identify primary objectives
2. Obtain a general overview of the building and review initial documentation
3. Develop a site-specific commissioning plan
4. Conduct a scoping meeting
5. Perform an initial site assessment
6. Develop an initial list of O&M improvements / opportunities
7. Develop a diagnostic monitoring and functional testing plan
8. Execute calibrations on selected equipment
9. Implement monitoring and testing
10. Analyze the monitoring and testing data, identify additional improvements and determine which O&M opportunities are most cost effective to implement

11. Implement and verify O&M improvements
12. Consider energy-efficient capital improvements
13. Commissioning final report

The scope of this project will be through step 10.

The following is an outline of the commissioning process for this project. The process may be modified once the initial assessment is completed.

1. Identify Primary Objectives

The project objectives have been listed previously.

2. Obtain a General Overview of the Building and Review Initial Documentation

This task was completed prior to developing this plan.

3. Develop a Site-Specific Commissioning Plan

The commissioning provider develops this plan with the Owner.

4. Conduct a Scoping Meeting

This meeting is held with the primary players in attendance to describe the process and discuss and coordinate the execution of the commissioning activities.

5. Perform an Operations Initial Site Assessment

The site assessment starts with a kick-off meeting where all parties meet to go over the overall commissioning plan, the *Building Operations Initial Assessment Procedures*, the *Authorization Protocols* document and the schedule.

The assessment entails gaining an in-depth understanding of how and why the building systems and equipment are currently operated and maintained and how that might be improved. This is accomplished by interviewing the facility operating and managing staff and by making site inspections of all primary energy using equipment. Control sequences, setpoints, control parameters and schedules are also closely examined. Actual equipment testing is not done during the assessment. Problems and improvements are identified solely by gaining information from facility staff, equipment vendors, the control system and written documentation.

A significant list of improvements will be generated from the assessment alone, prior to any monitoring or functional testing. The information coming from the assessment will also identify areas where formal monitoring and testing will be most beneficial to identify further operational improvements.

The assessment will typically consist of the following tasks:

1. Obtain an understanding of the building equipment and systems
2. Identify the largest energy using equipment and analyze utility bills for larger buildings
3. Identify the known most problematic control, operational and comfort problems
4. Identify the design and operational intent and control sequences. Document all missing control sequences.
5. Identify procedures to reduce unnecessary runtime and unnecessary capacity levels

6. Identify changes to control parameters, strategies, set points, sequences or needed maintenance that will optimize efficiency, comfort, operation and control
7. Document noticed problems of equipment condition (broken dampers, dirty coils, sensor calibration, etc.)
8. Identify any needed facility staff training
9. Scope the monitoring (determine feasibility of desired monitoring points and gather necessary nameplate data)
10. Identify any obvious upgrades to equipment that may be cost-effective
11. Document the assessment process and results

Additional procedural details of the assessment are found in *Building Operations Assessment Procedures*, in Appendix A. During the assessment, there will need to be staff available to work the control system to view schedules and setpoints.

6. Develop a List of O&M Improvements / Opportunities

During the site assessment, the commissioning provider begins to develop a master list of O&M improvements for possible implementation. The list includes the name of the system or piece of equipment involved, a description of the issue or problem, and a suggested solution. The list of opportunities and recommendations generated during the initial site assessment is submitted to the Maintenance Manager and owner for review, prior to developing a monitoring and testing plan.

7. Develop a Diagnostic Monitoring and Functional Testing Plan

Monitoring and Testing Scope

Form B-3, *Monitoring and Functional Testing Scope Outline* (to be provided later) provides a list of the equipment and components that are initially intended to be tested, the general modes and functions that will be tested, any expected sampling strategies and who executes the test. The Commissioning Provider develops this table after consulting with the Maintenance Manager and Site Manager in light of the results of the initial site assessment.

Monitoring Plan

The commissioning provider develops a diagnostic plan focused on equipment and systems as identified in the site assessment. Where possible, and only after calibration, the building's energy management control system (EMCS) will be used to monitor data. Portable dataloggers will be used for points that cannot be monitored by the EMCS.

Functional Testing Plan

As determined from the site assessment and from the monitored data, some equipment will be manually tested through various modes of operation. Detailed test procedure forms will be developed describing each specific procedure and the expected or correct response. These procedure forms will direct the testing and be used to document the results.

8. Execute Equipment Calibrations

The Commissioning Provider will provide forms for calibrating equipment sensors and actuators that will be trended. These are completed and provided to the Commissioning Provider. Successful completion of the calibrations is required prior to starting any monitoring, trending or manual functional testing.

9. Implement Monitoring and Testing

Monitoring

The commissioning provider provides a detailed request for required trend logs to the facility staff who execute the trends and provide the data to the Provider in the requested format (electronic CSV). The provider programs the dataloggers and installs them with the assistance of the facility staff. Facility staff will be responsible to actually install current transformers and watt transducers on wiring inside electrical cabinets. Facility staff are responsible to remove the sensors and dataloggers, package them and send them back to the provider for analysis after the end of the monitoring period.

Functional Testing

The commissioning provider oversees manual tests on selected equipment, with the tests being conducted by facility staff. Manual tests will be comprised of changing parameters, setpoints or conditions and observing and documenting the system or equipment response through various modes and conditions (both simulated and real).

For equipment that is being monitored with sufficient points, manual testing may be accomplished by changing the parameters, etc. during the monitored period. The monitored data is then examined and used to document and verify correct or incorrect operation.

10. Analyze Monitoring and Testing Data, Identify Additional Improvements and Determine Which O&M Opportunities are Most Cost Effective to Implement

Once the data is gathered from monitoring and testing, the commissioning provider analyzes the findings by comparing actual equipment operation to appropriate operation and to the control sequences (when available). Improvements are identified and documented.

The list of O&M opportunities is prioritized by the owner and the commissioning provider. Factors taken into account will be the impacts on: operations, comfort, energy savings, IAQ, asset value and the cost of the fix. The commissioning provider will provide estimates of energy savings and installation costs for this analysis.

Once the owner has decided which improvements they will implement, the commissioning provider will develop a plan for their implementation.

A interim report by the commissioning provider will be provided at this point which summarizes the activities to date.

THE FOLLOWING STEPS (11-13) ARE NOT A PART OF THE SCOPE OF THIS
PROJECT, BUT ARE LISTED FOR REFERENCE.

11. Implement and Verify O&M Improvements

The commissioning provider will develop an implementation plan for the improvements selected for implementation. The owner will finance the installation of the improvements. The [commissioning provider will oversee the installation of the improvements, owner will oversee the installation of the improvements and the commissioning provider will provide some assistance in a review and consulting mode]. Work may be completed by in-house as well as by contracted parties. Improvements will include, for selected equipment, the correction of unclear or incorrect documentation of control sequences of operation and to create the written sequences where they don't exist; and a listing of recommended training for facility staff.

Systems will be manually retested and trended to verify the completeness of the fix, as appropriate and as needed. Appropriateness and need will be determined based on the complexity and magnitude of impacts of the fix and the cost of retesting. The dataloggers [will, will not] be reinstalled after improvements are made to verify the fixes and for assisting in making energy savings calculations of the improvements.

12. Consider Energy-Efficient Capital Improvements

The list of possible cost-effective capital improvements to equipment that became obvious to the commissioning provider during the preceding work will be considered by the owner and commissioning provider. The outcome of this task will generally be a recommendation for a more detailed investigation of specific measures. Implementation will not be a part of the scope of this project.

13. Commissioning Final Report

The commissioning provider will prepare a final report that generally includes the following information:

- Executive summary
- Project background
- Building / systems listing and general description
- Scope of the commissioning project
- The "master list" of improvements with a description of which improvements were implemented
- A cost/savings analysis for the estimates of savings and the actual improvement costs for each improvement implemented (see methods below)
- List of capital improvements recommended for further investigation

In Appendix

- The commissioning plan
- The filled-out operations initial site assessment forms
- The EMCS trending plan and logger diagnostic / monitoring plan and annotated results
- All completed functional tests and results
- Corrected and created sequences of operation

The estimates of energy savings for the final report will be developed using primarily [engineering hand calculations, spreadsheet calculations, spreadsheet bin analysis, bin computer simulation, hourly computer simulation]. [select appropriate method, edit out others].

Progress Reports

The commissioning provider will develop and distribute bi-monthly periodic progress reports until the project is complete.

General Schedule

The original schedule is given below. The dates may change somewhat as the project progresses. The task list gives a good indication of the general scope of work and the order in which it will be undertaken. A detailed schedule will be developed by the Commissioning Provider. As work progresses, all parties will be notified of any schedule changes that may affect their specific tasks.

Table 1. Initial Schedule

Party	Task	Start	Finish
(Utility and Owner)	Reviews and approves proposal. Utility gives verbal go-		

	report to Utility and Owner		
(Cx Provider)	Presents recommendations to Utility and Owner		12/18
(Owner)	Decides on measures to implement	12/18	12/21
(Cx Provider)	Develops implementation plan and sends to Utility and Owner	12/22	12/23