State Of Idaho
Retrocommissioning Guidelines
12/20/99

1. Document Purpose

The purpose of this document is to describe guidelines for retrocommissioning State of Idaho buildings. Retrocommissioning is the process of optimizing the performance of existing building systems that have not been previously commissioned.

2. Document Background

This document presents guidelines for implementing retrocommissioning projects for State of Idaho buildings. All Idaho State commissioning projects shall be conducted in accordance with THE FUNDAMENTAL ELEMENTS OF COMMISSIONING STATE OF IDAHO BUILDINGS, which appears as an attachment to this document. THE FUNDAMENTAL ELEMENTS OF COMMISSIONING STATE OF IDAHO BUILDINGS was adapted from the Building Commissioning Association's *Essential Attributes of Building Commissioning.* An additional retrocommissioning reference is A Practical Guide for Commissioning Existing Buildings, prepared for the Office of Building Technology, State and Community Programs, U.S. Department of Energy by Portland Energy Conservation, Inc. and Oak Ridge National Laboratory. Many of the State of Idaho's retrocommissioning guidelines are adaptations from this document.

3. Retrocommissioning Goal

The primary goal of the retrocommissioning process is to optimize the performance of existing building systems with respect to the present usage of the building and the needs of its operating and maintenance staff.

4. Retrocommissioning Applications

The State of Idaho intends to apply the retrocommissioning process to three types of projects that are categorized as follows:

4.1 Typical retrocommissioning projects. Retrocommissioning is applicable to building systems that can continue to provide service without making major capital improvements. Major changes in system configuration and major equipment replacement are examples of capital projects that are outside of the scope of a retrocommissioning project.

4.2 Retrocommissioning investigation projects. The State of Idaho may, however, implement the Planning and Investigation Phases of the retrocommissioning process in order to establish whether or not a building has a need for a renovation project, which includes design, construction, and new-systems commissioning.

4.3 Mitigating retrocommissioning. Retrocommissioning is not intended as a means of keeping inefficient systems in service. In some cases, however, retrocommissioning analysis may indicate that the optimal course of action is a major renovation that is beyond the means of the Using Agency's budget. Under

these circumstances it may be preferable to judiciously initiate retrocommissioning to do what can be done with the existing system, and prioritize replacement and repairs for future budgeting purposes.

5. Definitions and Descriptions

The following definitions and descriptions apply to the terms used in this document:

5.1 Building Commissioning. Building Commissioning is the act of verifying and documenting that the performance and maintainability of building systems fulfill the functional and operational needs of the building's owner, using agency, and operators. It requires that these needs be documented as systems acceptance criteria, and that a formal process be implemented to verify and document that the systems are designed and constructed in accordance with these criteria. The ultimate goal of this process is to confirm, through functional testing, that the interactive operation of the building system complies with the acceptance criteria.

5.2 New-Building (and New-Systems) Commissioning. New-building commissioning is building commissioning applied to a new construction project, or to the installation of new building systems in existing building structures (i.e. completely replacing a building's HVAC or fire alarm systems). Commissioning of new systems in existing buildings may also be referred to as New-Systems Commissioning. New-building and new-systems commissioning for State of Idaho projects shall be conducted in accordance with Appendix VII, New Commissioning Guidelines.

5.3 Recommissioning. Once a building has been commissioned or retro-commissioned, periodic recommissioning may be done to verify that the systems continue to perform as documented in the original commissioning report. Generally this is accomplished by performing the functional test procedures from the original commissioning process. If the use or occupancy schedule of a building changes, however, the recommissioning process may have to include revising the system's performance criteria and the associated functional test procedures.

5.4 Retrocommissioning. Investigating, analyzing, and optimizing the performance of existing building systems that have not been previously commissioned is known as retrocommissioning. The process addresses the building's present use and occupancy profiles, therefore the original design intent may not be relevant if these have changed.

The replacement and major renovation of building systems goes beyond the scope of retrocommissioning. The State of Idaho may, however, implement the Planning and Investigation Phases of the retrocommissioning process in order to establish whether or not a building has a need for the design, construction, and new-systems commissioning of a renovation project.

6. Retrocommissioning Team.

Effective building commissioning requires a team effort. The commissioning team must include the project manager, agency, and building operators, with the commissioning authority as the team leader. Testing specialists may be needed on more complex projects, and designers, contractors, and equipment suppliers may be required to implement some systems improvements. The fundamental team member roles vary little from

project to project, but the level of effort for specific team members may differ with each project depending on the size of the facility and the nature of the project. This kind of flexibility is essential in order to serve the requirements of individual projects; for example, smaller projects may have overlapping or interchangeable roles for the team members. Typical members of the Retrocommissioning Team may be described as follows**:**

6.1 Owner/Agency

6.1.1 Project Manager (PM). The Division of Public Works (DPW) is the contracting authority for design and construction of public works projects for State owned facilities for numerous State agencies. DPW assigns a PM to manage projects. As the owner's representative, the PM is the primary owner's advocate and spokesperson through which all commissioning communication is channeled to and from the owner. The responsibilities of the PM are more specifically defined as follows:

6.1.1.1 Manage the initial process of assessing the suitability of the systems for retrocommissioning.

6.1.1.2 Manage the development of the project objectives and scope.

6.1.1.3 Manage the process of selecting the CA and negotiating their contract.

6.1.1.4 Manage the Owner/Agency's review of the CA's submittals, reports and documentation. Provide written comments on:

- The Systems' Acceptance Criteria (and the Systems Concept and Operation Manual, if this document is included in the scope of work).
- The Assessment, Investigation, and Analysis Documentation.
- The Functional Test Procedures.
- The Final Commissioning Report.
- Any retrocommissioning documentation for which Owner/Agency input or response is in order.

6.1.1.5 Assist in developing the Systems' Acceptance Criteria.

6.1.1.6 Help coordinate the involvement of the Agency Representative and Building Operating Staff.

6.1.1.7 Review the CA's submittals of the Assessment, Investigation, and Analysis Documentation.

6.1.1.8 Manage the selection of Improvement Options.

6.1.1.9 Assist in resolving commissioning issues during functional testing.

6.1.1.10 Coordinate final acceptance of the Project.

6.1.2 Agency Representative. The agency is the user of the building. The agency provides information regarding the functional and operational use of the facility and sets the operating requirements, such as the occupancy schedules, ventilation requirements for the various areas of the facility, and control and lighting requirements for the facility. The Agency Representative is the primary agency advocate and spokesperson through which all commissioning communication is channeled to and from the Agency. The commissioning authority and the flow of commissioning communication relative to the PM and the Agency Representative will be established individually for each project**.** The responsibilities of the Agency Representative are more specifically defined as follows:

6.1.2.1 Assess the suitability of the systems for retrocommissioning.

6.1.2.2 Assist in developing the project objectives and scope.

6.1.2.3 Participate in selecting the CA.

6.1.2.4 Review the CA's submittals, reports and documentation. Provide written comments on:

- The Systems' Acceptance Criteria (and the Systems Concept and Operation Manual, if this document is included in the scope of work).
- The Assessment, Investigation, and Analysis Documentation.
- The Functional Test Procedures.
- The Final Commissioning Report.
- Any retrocommissioning documentation for which Agency input or response is in order.

6.1.2.5 Assist in developing the Systems' Acceptance Criteria.

6.1.2.6 Provide building documentation.

6.1.2.7 Coordinate the involvement of the Building Operating Staff.

6.1.2.8 Coordinate project activities with the building occupants.

6.1.2.9 Provide information regarding occupant complaints, the present building usage and occupancy schedule, and long term plans for building usage and occupancy schedule.

6.1.2.10 Coordinate the involvement of the suppliers of existing equipment, if required.

6.1.2.11 Provide input for the selection of Improvement Options.

6.1.2.12 Assist in resolving commissioning issues during functional testing.

6.1.3 Building Operating Staff. The building operators provide information regarding systems' operation and condition. They participate in developing the Owner's Acceptance Criteria, assist in field assessment and testing, review results of the project investigation and analysis, and attend and evaluate the contractor and manufacturer training. They may also participate in functional performance testing. The building operators participate in the commissioning process through the Agency Representative. The responsibilities of the Building Operating Staff are more specifically defined as follows:

6.1.3.1 Assess the suitability of the systems for retrocommissioning.

6.1.3.2 Assist in developing the project objectives and scope.

6.1.3.3 Participate in selecting the CA.

6.1.3.4 Review the CA's submittals, reports and documentation. Provide written comments on:

- The Systems' Acceptance Criteria (and the Systems Concept and Operation Manual, if this document is included in the scope of work).
- The Assessment, Investigation, and Analysis Documentation.
- The Functional Test Procedures.
- The Final Commissioning Report.
- Any retrocommissioning documentation for which Building Operating Staff input or response is in order.

6.1.3.5 Assist in developing the Systems' Acceptance Criteria.

6.1.3.6 Provide information regarding performance and condition of the systems within the retrocommissioning scope of work.

6.1.3.7 Assist the CA with the Retrocommissioning Assessment and Investigation Phases.

6.1.3.8 Participate in field-testing.

6.1.3.9 Review the CA's submittals of the Assessment, Investigation, and Analysis Documentation.

6.1.3.10 Provide input for the selection of Improvement Options.

6.1.3.11 Review and participate in the implementation of the Functional Test Procedures.

6.1.3.12 Attend owner training sessions.

6.2 Commissioning Authority (CA). The CA is in charge of the commissioning process and makes the final recommendations to the owner regarding functional performance of the commissioned building systems. The CA conducts all State of Idaho commissioning projects in accordance with THE FUNDAMENTAL ELEMENTS OF COMMISSIONING STATE OF IDAHO BUILDINGS (ATTACHMENT 4 of the State of Idaho New-Building Commissioning Guidelines). For retrocommissioning projects the CA is under contract directly with the Owner. The responsibilities of the CA are more specifically defined as follows:

6.2.1 Manage the Retrocommissioning Process.

6.2.2 Manage the development of the Systems' Acceptance Criteria (and the Systems Concept and Operation Manual if required.)

6.2.3 Develop and update the Retrocommissioning Plan.

6.2.4 Manage and perform the Retrocommissioning Investigation.

6.2.5 Develop, implement, and update the field-testing plan.

6.2.6 Manage and/or perform the Retrocommissioning Analysis.

6.2.7 Develop and update the Functional Test Procedures.

6.2.8 Make recommendations to the Owner regarding performance and acceptance of the retrocommissioned systems.

6.2.9 Coordinate Owner Training.

6.2.10 Prepare the Retrocommissioning Report.

6.2.11 Schedule and perform post-acceptance commissioning activities (if required).

6.2.12 Prior to expiration of any equipment or construction warranties, or approximately one year after owner acceptance, assist the owner in assessing systems' performance and addressing related issues.

6.2.13 Respond to operator questions during the warranty period.

6.3 Additional Team Members. The increased scope of some retrocommissioning projects may require that additional members be added to the team. On some projects the retrocommissioning team may include the following:

6.3.1 Testing Specialists. Retrocommissioning projects with specialized systems may require the testing services of a specialist in that field: examples of this are high-level security systems, complex fire and life-safety systems, etc. In these cases the specialist becomes a part of the Retrocommissioning Team, typically under subcontract to the CA.

The responsibilities of Testing Specialists and Equipment Suppliers are determined by the PM and CA, and documented in the Retrocommissioning Plan on a project-by-project basis.

6.3.2 Equipment Suppliers. In some cases a Testing Specialist or some other form of analytical support may be required from equipment suppliers or manufacturers. Examples of this are systems or equipment that operate with significant proprietary control, such as manufacturer provided chiller or boiler controls, and some DDC system firmware and software. When this occurs, the owner must arrange for the equipment manufacturer or supplier to become a part of the Retrocommissioning Team. The responsibilities of Testing Specialists and Equipment Suppliers are determined by the PM and CA, and documented in the Retrocommissioning Plan on a project-by-project basis.

6.3.3 Contractors. Contractor support may be required to implement some retrocommissioning improvements. Contractors are integrated into the Retrocommissioning Team in accordance with the State of Idaho New-Building Commissioning Guidelines. All aspects of the New-Building Commissioning Guidelines pertaining to contractors may not apply to every retrocommissioning project. The Retrocommissioning Plan addresses which aspects of the New-Building Commissioning Guidelines apply on a project-by-project basis.

6.3.4 Designers. Because major retrofit work goes beyond the scope of most retrocommissioning improvements, the design services of an A/E team are not typically required for a retrocommissioning project. In the event that the CA and PM judge that the services of design engineers or architects are necessary, they are integrated into the Retrocommissioning Team in accordance with the State of Idaho New-Building Commissioning Guidelines. All aspects of the New-Building Commissioning Guidelines pertaining to A/E's may not apply to every retrocommissioning project. The Retrocommissioning Plan addresses which aspects of the New-Building Commissioning Guidelines apply on a project-by-project basis.

7. Retrocommissioning Plan. The Retrocommissioning Plan is the management plan for the Retrocommissioning Process. Due to the step-by-step evolution of a retrocommissioning project, the Retrocommissioning Plan evolves with the project.

7.1 The Initial Retrocommissioning Plan includes the following information:

- Identifies the initial assessment of the category into which the project falls (refer to Section 4.),
- Documents the project scope including the systems to be retrocommissioned,
- Defines the Commissioning Team, the roles of the team members, and the protocol for Commissioning Team communication,
- Documents the Systems Acceptance Criteria concepts,

- Specifies the procedure and format for documenting commissioning activities,
- Specifies the approach for the Investigation Phase, and
- Estimates the schedule of commissioning activities.

7.2 Retrocommissioning Plan development during the Investigation Phase includes adding the field-testing plan. If new members (such as equipment suppliers or other testing specialists) are added to the team at this phase, a description of their responsibilities is added to the Retrocommissioning Plan.

7.3 Retrocommissioning Plan development during the Implementation Phase includes specifying the functional testing process in accordance with the State of Idaho New-Building Commissioning Guidelines. If new members (such as contractors or designers) are added to the team at this phase, a description of their responsibilities is added to the Retrocommissioning Plan.

8. Final Retrocommissioning Report. During the project's acceptance phase, the Commissioning Authority submits a final Commissioning Report to the Owner. It includes the following information:

- The Investigation Phase Documentation,
- Documentation of the owner's selection of systems improvement options,
- The Implementation Phase Summary of Work and Acceptance Criteria,
- An evaluation of the operating condition of the systems at the time of functional test completion,
- Deficiencies that were discovered during functional testing and the measures taken to correct them,
- Uncorrected operational deficiencies that were accepted by the owner,
- Functional test procedures and results,
- A copy of the final balancing report if the systems were balanced,
- Reports that document all commissioning field activities as they progress, and
- A description and estimated schedule of required deferred testing.

9. The Retrocommissioning Process. Typical phases of the retrocommissioning process are further defined as follows. On extensive projects it may not be possible to determine the scope of the Analysis Phase until after the Investigation Phase is complete, and often the scope of the Implementation Phase cannot be determined until analysis and improvement selection is finished. For this reason

more extensive retrocommissioning projects may need to be performed in multiple steps with up to three separate contracts for the Planning/Investigation, Analysis, and Implementation Phases:

9.1 Planning Phase

9.1.1 Assess the suitability of the systems for retrocommissioning. Before beginning a retrocommissioning project the owner, agency and operating staff should do an initial assessment to determine whether or not the project is believed to fall into one of the retrocommissioning project categories described in the preceding Retrocommissioning Applications Section (4.). This initial assessment will be reviewed during the Investigation Phase of the project**.**

9.1.2 Define project objectives and scope.

9.1.3 Select commissioning authority and retrocommissioning team.

9.1.4 Begin defining and documenting The Systems' Acceptance Criteria. The Acceptance Criteria is the owner and using agency's criteria for acceptable systems' performance and maintainability. During the planning stage some concept of these criteria should exist and be documented. The CA manages the process of developing this.

9.1.5 Review building documentation. If the existing documentation is poor, it may need to be updated or redone during the assessment portion of the Investigation Phase.

9.1.6 Develop the Initial Retrocommissioning Plan. The Retrocommissioning Plan is the management plan for the Retrocommissioning Process. Due to the step-by-step evolution of a retrocommissioning project the Retrocommissioning Plan evolves with the project. The Initial Retrocommissioning Plan includes the following information**:**

- Identifies the initial assessment of the category into which the project falls (refer to Section 4.),
- Documents the project scope including the systems to be retrocommissioned,
- Defines the Commissioning Team, the roles of the team members, and the protocol for Commissioning Team communication,
- Documents the Systems' Acceptance Criteria concepts,
- Specifies the procedure and format for documenting commissioning activities,
- Specifies the approach for the Investigation Phase, and
- Estimates the schedule of commissioning activities.

9.2 Investigation Phase

9.2.1 Assess existing conditions. The investigation phase begins with a field assessment of the existing conditions based on field observations of the facility and interviews with key occupants and operating staff. Information and conclusions obtained from this assessment are used to confirm that the systems are suitable for a retrocommissioning project and to develop the field-testing plan.

9.2.1.1 Issues addressed. The following aspects of the building systems are included in the assessment portion of the Investigation Phase:

- **Condition of the systems and their major equipment.** Confirm that the systems fall into one of the project categories described under Retrocommissioning Applications in Section 4.
- **Energy use.** Review energy usage relative to similar buildings.

- **Building documentation**. During this phase of the project the building documentation should be verified and updated if required. In the absence of adequate documentation as-built one-line schematic drawings may need to be developed.
- **The suitability of the operating characteristics and sequences of operation of the existing systems relative to the present building use and schedule.**
  - **Reported systems operation and control problems.**
  - **Reported comfort and indoor air quality issues.**
  - **O & M practices and staffing.** The preferences, abilities, and workload of the operating staff are important considerations for determining appropriate systems improvements.

9.2.1.2 Field Assessment Documentation. The following documentation should be prepared during the assessment portion of the Investigation Phase. All field Assessment Documentation is included in the Final Commissioning Report.

- **Updated building documentation.**
- **Updated Systems' Acceptance Criteria.**
- **Verification of retrocommissioning project category.**
- **Description of the existing conditions addressing the issues outlined in 5.4.2.1.2.**
- **A description of known and suspected system deficiencies, and potential corrective options to be verified by field-testing.**

9.2.2 Field-testing. Based on the field assessment a field-testing plan is developed and followed to perform diagnostic testing of existing

systems performance. The test plan is added to the Commissioning Plan. All field testing and the results are documented and included in the Final Commissioning Report. Depending on whether or not the condition of the existing equipment warrants reuse, field-testing may include the following:

- EMCS trend-logging.
- Portable data-logging.
- TAB measurements.
- Functional testing.

9.3 Analysis Phase. Analyze systems, and develop and evaluate options for system improvements. Guidelines for the analysis include:

9.3.1. Analysis addresses the Systems' Acceptance Criteria. The analysis phase begins by verifying that the Systems' Acceptance Criteria are complete. By this point the Acceptance Criteria includes:

- Energy efficiency. The analysis addresses the effect of improvements on energy usage.
- Occupant comfort and productivity.
- Maintaining acceptable indoor air quality.
- System operating characteristics.
- Operation and Maintenance.

9.3.2 Improvement options may range from minor in-house O& M changes to major retrofit construction projects.

9.3.3 Options are prioritized based on overall importance and cost effectiveness.

9.3.4 The extent of computer modeling and economic analysis will be determined by the State on a project-by-project basis. Typically the CA will be asked to make recommendations regarding this.

9.3.5 A Written Report summarizes the results of investigation and analysis for the owner. This report, which is included in the Final Commissioning Report, includes the following:

- The Field Assessment Documentation.
- The Field-testing Documentation.
- A summary description of the improvement analysis that was done, including the method of analysis, the assumptions on which the analysis is based, and the results and conclusions.
- A table summarizing the comparative priorities and economic analysis of each improvement option that appears viable.

9.4 Selection of Options. The owner and agency select the improvement options that will be implemented. The owner provides the Commissioning Authority with written notification of the selections they have made and the means they have chosen for implementing them. This document is included in the Final Commissioning Report.

9.5 Implementation Phase.

9.5.1 Document summary of work and acceptance criteria for the selected improvement options. For major modifications to systems or their sequences of operation a Systems Concept and Operation Manual is developed in accordance with the State of Idaho's New-Building Commissioning Guidelines. All aspects of the New-Building Commissioning Guidelines pertaining to The Systems Concept and Operation Manual may not apply to every retrocommissioning project. The Retrocommissioning Plan addresses which aspects of the New-Building Commissioning Guidelines apply on a project-by-project basis.

9.5.2 Implement improvements. Depending on the scope of the project, implementation is done by the operating staff, under direct contract with equipment suppliers, as a design-build project, or through a formal design-bid-build process. Implementation is commissioned in accordance with the State of Idaho's New-Building Commissioning Guidelines. All aspects of the New-Building Commissioning Guidelines may not apply to every retrocommissioning project. The Retrocommissioning Plan addresses which aspects of the New-Building Commissioning Guidelines apply on a project-by-project basis.

9.5.3 Functional Performance Testing. The Commissioning Authority conducts functional performance testing on all implemented improvements in accordance with the State of Idaho's New-Building Commissioning Guidelines.

9.5.4 Operation & Maintenance Manuals. Installation or major modification of major equipment or systems is accompanied by an Operation & Maintenance Manual provided in accordance with the State of Idaho's New-Building Commissioning Guidelines.

9.5.5 Training of the operating staff. Installation or major modification of major equipment or systems is accompanied by training of the operating staff in accordance with the State of Idaho's New-Building Commissioning Guidelines.

9.5.6 Final Commissioning Report. The Commissioning Authority submits the Final Commissioning Report to the Owner.

9.6 Post-Acceptance Functional Testing and Evaluation. For some projects, retrocommissioning testing and evaluation may continue after the Owner/Agency has accepted the systems. Examples of post-acceptance retrocommissioning activities are:

9.6.1 Functional testing of the systems during peak heating and cooling seasons, heating and cooling transitional seasons, or part load conditions that were not encountered during the original functional testing period. The Commissioning Team determines the need for this activity on a project-by-project basis depending on building history, systems' operating criteria, and functional test procedure results.

9.6.2 Prior to expiration of any equipment or construction warranties, or approximately one year after owner acceptance, the CA assists the owner in assessing systems' performance and

addressing related issues. The Commissioning Team determines the need and scope for this on a project-by-project basis depending on building history, systems' operating criteria, and functional test procedure results. The scope of this activity will typically consist of an onsite walkthrough and reviewing trend-logged data and O&M reports. More extensive or complex projects, or more critical systems, may warrant more extensive field testing and assessment.

9.6.3 The Retrocommissioning Team responds to operator questions during the warranty period.