



BSR/ASHRAE Standard 230P

**Public Review Draft**

# Commissioning Process for Existing Systems and Assemblies

First Public Review (**September 2021**)  
(Draft Shows Complete Proposed New Standard)

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## **FOREWORD**

*BSR/ASHRAE Standard 230P, Commissioning Process for Existing Systems and Assemblies, is an organized, quality-oriented process for planning, assessing, investigating, implementing, verifying, and documenting repair and adjustment activities for improving the performance of facilities, systems, and assemblies to meet defined operational requirements and criteria for the facility.*

### ***The Existing Building Commissioning Process***

*The existing building commissioning process (EBCx) is used by Owners and/or facility decision-makers to optimize the operation of their facilities and systems for their specific Current Facility Requirements (CFR) and meet applicable jurisdictional requirements. The process is used to establish facility operation baselines, establish performance goals, and compare preexisting conditions and operations to post-implementation goals. This evaluation allows the Owner to determine if any of the existing conditions require or warrant further attention or building tune-up. The EBCx is also used to identify the causes of existing problems and shortfalls in achieving the CFR and to determine methods for resolving those problems. Most importantly, the process provides the Owner with a logical decision-making approach to evaluate, compare, prioritize, and implement recommendations for making their facilities operate as efficiently and effectively as is economically feasible, given the Owner's specific requirements and resources and potential jurisdictional requirements. When physical changes to the facility are required because of the EBCx, all such modifications must meet applicable codes pertaining to the work being performed. Additionally, following the process allows Owners to maintain the benefits of these implemented recommendations over time.*

*The EBCx differs from the Cx process for new buildings in that the Cx Team for existing buildings is selected and charged with evaluating existing building systems and assemblies to determine their ability to meet the Owner's CFR, which may differ from the original design and Owner's project requirements (OPR). Energy efficiency measures (EEM), system and facility upgrades, and major equipment replacement should utilize the new building commissioning process in ANSI/ASHRAE/IES Standard 202, Commissioning Process for New Buildings and New Systems, during implementation.*

*This standard details a process that can be applied to any type of building, system, or assembly. The EBCx consists of distinct phases with specific objectives to be achieved during each phase to identify and correct operational and functional issues that prevent the building systems and assemblies from performing as currently required. The process involves the follow phases: Planning, Assessment, Investigation, Implementation, and Hand-Off. This standard describes the responsibilities of the Cx Team and the documents and reports needed to provide a uniform, integrated, and consistent approach for maintaining, operating, and managing assets to meet the Owner's and other stakeholders' ongoing requirements.*

*Some jurisdictions have implemented a mandatory existing building commissioning, retrocommissioning, or building tune-up requirement. These requirements may reference or utilize the same basic activities and procedures with different terminology and documentation levels. This standard describes a process intended to provide minimum requirements, activities, and uniformity in processes, documentation, and results for EBCx scopes covered by this standard, ranging from basic system repairs, system tune-up, and/or in-kind replacement to achieve performance goals defined in the CFR. Owners may elect to use the more comprehensive approach described in ASHRAE Guideline 0.2, The Commissioning Process for Existing Systems and Assemblies, rather than this minimum standard.*

*Existing building commissioning provides one of the greatest opportunities to improve energy efficiency and improve occupant satisfaction/productivity in the existing building stock. The EBCx also provides good stewardship of our planet's resources while raising occupant quality of life, and probability of the building's stakeholders. However, the extent of deferred maintenance or change in occupant mission can move the value of the existing building where replacement is a more cost-effective approach. For existing buildings where replacement or major renovation (complete gut) is desired by the Owner, ANSI/ASHRAE/IES Standard 202, Commissioning Process for New Buildings and New Systems, should be implemented. Existing buildings with additions, modifications requiring design and construction during the implementation phase of this standard and specific incorporation of sections of*

*ANSI/ASHRAE/IES Standard 202 for new design and construction activities performed on an existing building within this standard.*

*Existing buildings, systems, and assemblies not slated for removal or major renovation can utilize the EBCx to raise the building performance to meet local, state, and federal codes enforced by the governing authority having jurisdiction (AHJ). Existing building commissioning project teams typically include building operation and maintenance staff, controls contractors, testing, adjusting, and balancing (TAB) contractors, mechanical and electrical contractors, and commissioning process providers (CxPs).*

## 1. PURPOSE

The purpose is to identify the minimum acceptable Commissioning Process for existing buildings and systems.

## 2. SCOPE

This standard provides procedures, methods, and documentation requirements for each commissioning activity from planning to assessment, investigation, implementation, hand-off, and initial ongoing commissioning, including:

- a. overview of existing building commissioning process activities
- b. description of minimum activities for each process step
- c. minimum documentation requirements for each process step

## 3. DEFINITIONS

**3.1 General.** Certain terms, abbreviations, and acronyms are defined in this section for the purposes of this standard. These definitions are applicable to all sections of this standard. Terms that are not defined herein, but that are defined in standards and guidelines that are referenced herein, shall have the meanings as defined in the referenced standards and guidelines. Other terms that are not defined herein shall have their ordinarily accepted meanings within the context in which they are used. Ordinarily accepted meanings shall be based on American Standard English language use, as documented in an unabridged dictionary accepted by the authority having jurisdiction (AHJ).

**acceptance:** a formal action, taken by a person with appropriate authority (which may or may not be contractually defined), to declare that some aspect of the project meets defined requirements, thus permitting subsequent activities to proceed.

**authority having jurisdiction (AHJ):** the agency or agent responsible for enforcing this standard.

**baseline:** establishing current measurable parameters such as occupant satisfaction and water and energy consumption rates by which improvements will be evaluated against in the benchmarking activities.

**checklists:** project and element-specific checklists that are developed and used during all phases of the EBCx to verify that the CFR is being achieved. Checklists are used for general evaluation, testing, training, and other process and construction requirements.

**Current Facility Requirements (CFR):** a written document that details the current functional requirements of an existing facility and the expectations for how it should be used and operated, including goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information to meet the requirements of occupants, users, and Owners of the facility. If an OPR (Owner's Project Requirements) exists, it is renamed as a CFR and is used over the life of the building to document the Owners' objectives and criteria as mission and facility usage changes.

**Cx Activities:** components of the Cx.

**Cx Provider (CxP):** an entity, identified by the Owner, who leads, plans, schedules, and coordinates the CxP Team to implement the Cx.

**Cx Provider Team (CxP Team):** the team of specialists and related support staff who are responsible for the management of actions and the generation of deliverables by the CxP as outlined in the contract between the

Owner and the CxP and in the Cx Plan. The CxP Team may consist of several companies, including subcontractors to the CxP who acts as the contact to the Owner.

***EBCx Plan:*** a document that outlines the organization, schedule, allocation of resources, and documentation requirements for the scope of work defined by the Owner. The EBCx Plan includes specific facility information, team contacts, scope of work, procedures, execution schedule, and requirements of the EBCx.

***EBCx Team:*** Owner staff, O&M entity, and CxP Team working in collaboration to execute the EBCx Plan to achieve the CFR.

***Energy Cost Index (ECI):*** the total annual energy cost for the building divided by the gross floor area.

***energy efficiency measure (EEM):*** an action taken in the operation or equipment in a building that reduces energy use of the building while maintaining or enhancing the building's safety, comfort, and functionality; also referred to as "energy conservation measure" (ECM).

***energy use intensity (EUI):*** total annual building energy use divided by the gross floor area. The EUI may be expressed as a site energy EUI or a building energy EUI.

***evaluation:*** the process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems and their performance are confirmed with respect to the criteria required in the OPR.

***Existing Building Cx (EBCx):*** a quality-focused process for attaining the CFR of an existing facility and its systems and assemblies being commissioned. The process focuses on planning, investigating, implementing, verifying, and documenting that the facility and/or its systems and assemblies are operated and maintained to meet the CFR, with a recommendation to implement continuous improvement for the remaining life of the facility.

***Facility Guide:*** similar to an operator's manual, the Facility Guide is intended to provide the basic information necessary for the building operations staff to operate the building on a day-to-day basis. It includes a simple description of the building systems and their normal operation, schedules, set points, and limitations. The Facility Guide also includes routine maintenance for the systems to keep them in good condition, but not major maintenance or repair functions. Scheduled start-up and shutdown functions should be included. Refer to ASHRAE Guideline 1.4, *Preparing Systems Manuals for Facilities*, for additional information.

***facility improvement measure (FIM):*** an action taken in the operation or equipment in a building that improves efficiency and/or quality or reduces costs. This includes energy efficiency measures (EEMs), but also includes non-energy actions with quantifiable results, such as operational, maintenance, indoor environment quality (IEQ), comfort, safety, or other quality or performance improvements.

***gross floor area:*** the sum of the floor areas of all the spaces within the building with no deductions for floor penetrations other than atria. It is measured from the exterior faces of exterior walls or from the centerline of walls separating buildings, but excludes covered walkways, open roofed-over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, roof overhangs, parking garages, surface parking, and similar features.

***issues and resolution log:*** a formal and ongoing record of problems or concerns and their resolution that have been compiled by members of the CxP Team during the course of the Cx.

***measurement and verification (M&V) plan:*** the process which defines how the savings analysis will be conducted before the ECM is implemented. This provides a degree of objectivity that is absent if the savings are simply evaluated after implementation.

***Ongoing Cx (OCx):*** a continuation of the Cx well into occupancy and operations to continually improve the operation and performance of a facility to meet current and evolving CFR or OPR. Ongoing Cx Activities occur throughout the life of the facility; some of these will be close to continuous in implementation, and others will be either scheduled or unscheduled as needed.

***progress report:*** a written document detailing activities completed as part of the Cx, and significant findings from those activities, that is continuously updated during the course of a project.

***Systems Manual:*** a system-focused composite document that includes the design and construction

documentation, Facility Guide and operation manual, maintenance information, training information, Cx records, and additional information of use to the Owner during occupancy and operations.

**test procedure:** a written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems to verify compliance with the CFR.

**testing:** the evaluation and documentation of the equipment and assemblies through observation of active simulations and passive performance within naturally occurring operating parameters.

**training plan:** a written document that details the expectations, schedule, duration, and deliverables for Cx Activities related to training of project operations and maintenance personnel, users, and occupants.

**system tune-up:** assessment and implementation of operational and maintenance improvements to achieve energy and water efficiency through EBCx that assess systems operation and condition and bring them to CFR or original design performance levels.

## 4. Utilization

**4.1 Introduction.** Existing buildings and systems degrade over time as equipment or components fail, sensors lose calibration, and adjustments or overrides are made to control parameters. When the Owner or AHJ deems that the facility requires adjustments or repairs, then, as a minimum, the process in this standard shall be followed. The scope will depend on the goals and objectives of the Owner and requirements of AHJs. The Owner and AHJ requirements shall be documented in the Current Facility Requirements (CFR). The application of this standard applies to the improvement of all or selected systems and assemblies in the existing building scope as defined in the CFR and the EBCx Plan (which also defines the EBCx Team roles, responsibilities, and schedules of EBCx activities). The process described in this standard is written for a generic project and shall be adapted to each project. Additional supplemental information is available in companion technical documents and guidelines that describe the specific details for implementation to a specific facility, system, or assembly. Existing buildings with additions and/or modifications requiring design and construction during the implementation phase of this standard shall utilize specific sections of ANSI/ASHRAE/IES Standard 202 for new design and construction activities performed to an existing building, in accordance with this standard.

### 4.2 EBCx Scope

**4.2.1** The Owner shall develop the EBCx scope on which the CxP will base their service proposal. The EBCx scope shall direct internal and external resources required to fulfill the requirements of this standard. The EBCx scope shall define the required qualifications of the CxP, overall goals and objectives expected from the EBCx, a narrative that describes systems to be commissioned, and facility information included in Section 5.2.1.2.1.1, “Facility Summary” in the commissioning scope.

#### 4.2.2 CxP Team Selection

**4.2.2.1** The Owner is responsible for selecting a qualified CxP Team. The CxP directs the EBCx process and shall be an objective advocate of the Owner.

### 4.3 Compliance Requirements

**4.3.1** The EBCx shall evaluate the existing building/facility against the criteria, goals, and objectives established in the CFR. The CxP Team shall identify repairs, in-kind replacements, and adjustments to the systems included in the EBCx scope. The Owner shall select repairs, in-kind replacements, and adjustments to the systems to be implemented within the facilities’ O&M budget to endeavor bringing the building/facility and its systems in compliance with the CFR. Deficiencies that are not specified to be corrected within the current O&M budget shall be listed as needing further attention from the Owner in the EBCx project final report. The Owner is responsible for providing a schedule for completion of remaining repairs. Modifications or replacements of equipment identified during the EBCx requiring design for new or modified systems shall follow ANSI/ASHRAE/IES Standard 202, *Commissioning Process for New Buildings and New Systems*.

**4.3.2** The CxP is not expected to perform repairs, in-kind replacement, or adjustments, but rather to lead the EBCx Team in identifying deficiencies and verification of completed work. The Owner shall engage the necessary and qualified people to correct the deficiencies, or the CxP shall document these deficiencies as not corrected.

**4.3.3** The EBCx shall include the following:

- a. establishing the minimum activities for the application of the EBCx in planning, assessment, investigation, implementation, and hand-off
- b. establishing the sequence of activities
- c. establishing the required deliverables and documentation
- d. producing EBCx progress reports on a monthly basis

## **5. STARTING THE EXISTING BUILDING COMMISSIONING PROCESS**

### **5.1 General**

**5.1.1 Introduction.** EBCx is a collaborative team effort beginning with collection of information from the project Owner, their staff, internal or external O&M members, and various occupants. Organizing information received into the Systems Manual provides a single repository of building information essential to operation, maintenance, and future modifications to the facility. The CFR becomes part of the Systems Manual and provides a snapshot at the beginning of the EBCx that defines the building attributes needed to support the mission of the current building occupants and the Owner's goals and objectives for the facility. The CFR provides the basis for evaluation of existing buildings and systems against the current needs to support the occupants' missions and the Owners' vision for the facility. The CFR provides the road map for the EBCx effort that the CxP Team will follow during the assessment, investigation, implementation, and hand-off phases of EBCx.

### **5.2 Planning Requirements**

#### **5.2.1 Roles and Responsibilities**

##### **5.2.1.1 Owner's Responsibilities**

**5.2.1.1.1 Facility Information.** The Owner shall provide to CxP all available facility information including:

- a. construction documents (drawings; specifications; submittals, especially HVAC controls; as-builts; previous modifications to the facility)
- b. utility usage/bills (energy and water)
- c. scheduled maintenance worksheets and work order history for systems included in the EBCx scope
- d. previous new construction commissioning Systems Manual, including its final commissioning report, or previous EBCx systems and facility manuals (as applicable, from previous projects)
- e. any previous consultant reports for systems included in EBCx scope (as applicable)
- f. utility rates, suppliers, and meter (and submeter) locations, data availability (hard copy or electronic)
- g. operation and maintenance plan
- h. operation and maintenance report of operating problems, malfunctioning equipment, maintenance costs, revisions to O&M procedures pertaining to systems included in Cx scope
- i. annual maintenance cost breakdown of interior building costs, building enclosure maintenance cost, and repair budget
- j. number of computers in building (including IT servers in data rooms)
- k. onsite energy production (as applicable)
- l. any occupant surveys conducted

**5.2.1.2 Owner's Participation.** Owner and/or their designated representatives shall:

- a. provide direction, reviews, and acceptance as required throughout the EBCx project
- b. develop the CFR or certify that the CFR is developed and approved prior to development of the EBCx plan
- c. confirm with the CxP that the CFR complies with the requirements of this standard, and modify or direction modification of the CFR to comply with the requirements of this standard

- d. attend EBCx planning meetings
- e. provide contact information and access to Owner's team leader (main point of contact), building manager, and support staff involved in EBCx project to the CxP
- f. make Owner's team members participate in EBCx activities (interviews, CFR development) including related staff and vendors
- g. confirm CxP develops EBCx plan and provide approval prior to the start of the EBCx investigative phase
- h. establish a protocol for ranking the order in which facilities are commissioned, if multiple facilities are to be commissioned as part of the EBCx scope
- i. provide history of building operation training activities
- j. provide occupant schedules and limitations of access for performing EBCx activities to CxP
- k. provide the CxP Team access required to perform EBCx activities
- l. disseminate surveys, schedule of EBCx activities, communication protocols provided by CxP to stakeholders
- m. determine which recommendations developed through the EBCx shall be implemented and the associated time frame for implementation
- n. review and approve commissioning assessment, investigation, implementation, and hand-off reports
- o. review and approve the ongoing commissioning (OCx) implementation plan
- p. review building automation system graphics and points that are being trended
- q. develop deferred maintenance correction plans

#### **5.2.1.2.1 Development of Current Facility Requirements**

- a. The Owner is responsible for the development of the CFR that clearly defines the Owner's requirements in a measurable way. This section establishes the minimum content required in the CFR document. The CFR shall clearly define the commissioning scope of work being executed in the EBCx Plan. If using a previous OPR, change the name and update to a CFR to meeting current Owner requirements, including future area modifications, additions, and upgrades that are beyond the current EBCx scope.
- b. The Owner shall provide a CFR that meet the requirements of this standard prior to CxP development of EBCx Plan.

**5.2.1.2.1.1 Facility Summary.** A narrative describing facility location, size, occupancy type, construction, systems, and facility usage.

#### **5.2.1.2.1.2 Owners' Goals and Objectives**

- a. authority having jurisdiction (AHJ) regulatory and jurisdictional requirements
- b. business model for investing in building improvements/modifications, including return on investment (ROI) or rate of return (ROR) criteria
- c. defined outcome of the EBCx process
- d. level of facility condition assessment
- e. sustainability goals
- f. training objectives for occupants, operation, and maintenance staff
- g. system documentation requirements (as-built, updated sequence of operations)
- h. benchmarking procedures to measure achieve of CFR goals
- i. operation and maintenance planning and execution requirements
- j. sampling procedures, if permitted, for all reviews, evaluations, and testing
- k. measurement and verification approach to validate selected metrics
- l. measurement and verification approach to validate changes in energy and water usage
- m. requirements and procedures for approval and updating of documents and plans
- n. ongoing commissioning level of implementation

- o. EBCx project deliverables and schedule

#### **5.2.1.2.1.3 User/Occupant Requirements**

- a. indoor environmental requirements (temperature, humidity, air quality, ventilation, lighting)
- b. occupancy schedules
- c. functional activities/tasks performed in building and associated requirements to facilitate efficient execution of occupant mission

#### **5.2.1.2.1.4 Owner Directed Requirements**

- a. preferred vendors/contractors

#### **5.2.1.2.1.5 Baseline Development**

- a. establish occupancy schedule and weather normalized baselines for energy and water usage
- b. develop schedule for updating subsequent baselines that coincide with completion of modifications and the one-year anniversary for evaluation in meeting CFR criteria. Provide access to data that CxP requires for development of benchmarking report

### **5.2.1.3 CxP Responsibilities**

#### **5.2.1.3.1 Processing Owner Provided Information**

- a. assemble a CxP Team with the technical expertise required to perform the EBCx scope of work
- b. organize information received from the Owner in the format of the Systems Manual. If information defined in Section 5.2.1.1, "Owner's Responsibilities" is incomplete, identify missing information and discuss issue with Owner
- c. evaluate Owner-provided CFR and verify that the CFR has the required information contained in Section 5.2.1.3.2.1, "Table of Contents," and that the information is clear in meaning and defines measurable project criteria
- d. provide appropriate comments and recommendations as needed for the CFR to meet this standard
- e. if the CFR is part of the CxP EBCx scope, the CxP shall assist the Owner with development of the CFR in accordance with this standards and approval of the CxP developed CFR document

**5.2.1.3.2 Systems Manual Development.** The Systems Manual shall contain Owner-provided information received during the planning phase plus information gathered and developed during the EBCx. Information gathered shall be converted to an electronic format will be searchable, as directed by the Owner.

#### **5.2.1.3.2.1 Table of Contents**

- a. Executive summary
- b. Previous Systems Manual information
- c. EBCx Systems Manual
  - 1. Current Facility Requirements
  - 2. EBCx Project Team contact information
  - 3. Facility benchmarks
  - 4. Facility Guide
  - 5. Training
  - 6. EBCx Plan
  - 7. EBCx Assessment Report
  - 8. EBCx Investigation Report
  - 9. EBCx Implementation Report
  - 10. Miscellaneous information



**5.2.1.3.3 Occupant Survey.** The occupant survey shall ask questions to evaluate the level of satisfaction of the occupants and the impact their workspace has on their efficiency to perform their tasks and their requirements contained in the CFR.

**5.2.1.3.3.1 Minimum Content**

- a. Percentage of time spent in the building
- b. Age range (under 35, 35 to 50, over 50)
- c. Type of space (private office, open office, cubicle, laboratory, etc.)
- d. Acoustical privacy
- e. Ambient noise negatively impacting concentration
- f. Perception of thermal comfort (hot, warm, slightly warm, neutral, slightly cold, cold) and areas of the body comfort affected (neck, back, arms, hands, thighs, lower legs, feet)
- g. Adequate lighting for tasks performed
- h. Visual comfort
  1. Light quality impacting tasks performed
  2. Lighting color discrimination
  3. Problematic light flicker
  4. Glare
  5. Difficulty seeing computer screen
  6. Adequacy of light levels in common areas
- i. Indoor Air Quality
  1. Air quality (stuffy/stale conditions)
  2. Unpleasant odors (food, carpet, other occupants, perfume, cleaning products, outside sources)
- j. Approximate or specific location in building

**5.2.1.3.4 CxP Planning Phase Deliverables**

- a. Draft Systems Manual containing all documentation received from the Owner during the planning stage
- b. Owner-approved CFR
- c. Occupant satisfaction survey for Owner distribution
- d. Proposed schedule of EBCx activities beginning with project kickoff through project hand-off

## **6. ASSESSMENT**

**6.1 Introduction.** The assessment period consists of evaluation and analysis of information received in the planning phase, development of EBCx Plan, and initial benchmarks in preparation for data collection during the Investigation Phase, visual evaluations that document general building conditions and operations of systems included in the EBCx scope to be conveyed in the project assessments phase report.

### **6.2 Requirements**

#### **6.2.1 Roles and Responsibilities**

##### **6.2.1.1 Owner**

- a. Distribution of occupant survey
- b. Establishment of a budget for low-cost repairs to be performed within the O&M budget for the facility, where such a budget exists. If no budget exists, the Owner shall develop a budget for low-cost repairs.
- c. Review and approval of EBCx Plan

##### **6.2.1.2 CxP Team**

#### **6.2.1.2.1 Data Processing**

- a. Use utility data to develop Preliminary Energy Use Analysis (PEA) and Energy Cost Index (ECI) with End-Use Breakdown, and compare EUI to a Peer Sample in accordance with ANSI/ASHRAE/ACCA Standard 211, *Standard for Commercial Building Energy Audits*, to establish an initial benchmark prior to the start of the EBCx investigation phase.
- b. Analyze scheduled maintenance documentation and work order history to identify areas needing investigation.
- c. Establish benchmarks for annual MEP maintenance cost, building enclosure maintenance cost, list of equipment not in service, water consumption both internal and external to the facility.
- d. Analyze occupant survey data to identify areas needing investigation.
- e. Develop M&V Plan that defines the data to be collected during the EBCx and evaluation procedures for report results before and after modification performed during the EBCx.
- f. Review building documentation to understand systems, their purpose, and location within the facility.
- g. Develop commissioning checklists and test procedures for evaluation of equipment and systems in the EBCx scope.
- h. Review utility rate schedules and incentives from government and utilities that would benefit the EBCx project.
- i. Define commissioning scope limitations resulting from a void in Owner-provided information and impact upon evaluation efforts required by the CFR and this standard.

**6.2.1.2.2 Project Information Documentation.** Provide information received from the Owner as required in Section 5.2.1.1.1(f), of this standard.

#### **6.2.1.2.3 EBCx Plan**

##### **6.2.1.2.3.1 Table of Contents**

- a. EBCx mission statement
- b. Project information
- c. Key contact information for EBCx Team members
- d. Communications protocols
- e. EBCx project scope
- f. Roles and responsibilities of EBCx Team members
- g. Investigation procedures, checklists, and test forms
- h. Schedule of investigation activities
- i. Example report formats (investigation field reports, testing reports, and issues and resolution log)
- j. Training Plan
- k. M&V Plan defining data collection and analysis procedures

##### **6.2.1.2.3.2 EBCx Plan Approval**

- a. Submit to Owner for approval. If the Owner reviews and approves the EBCx Plan and CFR, the EBCx Team shall proceed with Section 7, "Investigation."
- b. If the Owner does not approve, the EBCx Team shall resolve comments and obtain the Owner's approval.

#### **6.2.1.2.4 Acceptance Report Table of Contents**

- a. Updated Systems Manual with information developed in the assessment phase
- b. EBCx Plan

## **7. INVESTIGATION**

**7.1 Introduction.** During this phase, additional information is gathered on building systems through observations and testing to determine if the system and its components contained in the EBCx scope are performing in accordance with the CFR criteria. The execution of investigation is for the purpose of evaluating component, equipment, system, and assembly performance against the CFR criteria. This work is performed in a methodical fashion, in accordance with the EBCx Plan, providing data for additional analysis and identification of issues impacting their performance that require correction to meet the CFR.

## **7.2 Requirements**

### **7.2.1 Roles and Responsibilities**

**7.2.1.1 Owner.** The Owner's team shall:

- a. provide support and activities in accordance with this standard and the approved EBCx Plan.
- b. facilitate kickoff meeting space and ensure participation of Owner staff engaged in EBCx.
- c. provide access to areas required to perform EBCx activities. If CxP is required to be accompanied by assigned Owner staff, the Owner staff accompanying the CxP Team shall be dedicated to the Cx Team during the duration of EBCx Team activities.
- d. review field reports and issues and resolution log and attend meetings with CxP to resolve conditions impeding the execution of the EBCx Plan.
- e. review of the Cx investigation report, provide comments as appropriate, select recommendations to be implemented, and approval of proceeding to implementation phase.
- f. in collaboration with the EBCx Team, develop a plan to accept or resolve unresolved issues identified during this phase of the EBCx. Update the EBCx Plan as required due to reconciliation of comments affecting the CFR, Owner's EBCx objectives, scope and budget of the work, or other activities.

#### **7.2.1.2 CxP Team**

- a. Execute the investigation methodology and schedule as defined in the EBCx Plan
- b. Provide field and test reports on a weekly basis with the issues and resolution log
- c. Provide regular progress reports as EBCx Plan is executed and identify conditions impeding execution of the EBCx Plan
- d. Review unresolved issues with Owner and work collaboratively to develop a plan for resolution and acceptance

**7.2.1.2.1 Investigation Report.** The investigation report provides the bases of information required to determine where the CxP recommends the Owner put resources toward achieving the CFR.

#### **7.2.1.2.2 Table of Contents**

- a. Executive summary
- b. Issues and resolution log
- c. Adjustments and modifications (calibration reports, changes in set points, minor repairs, BAS modifications)
- d. Investigation documentation (field, test, progress, technical reports)
- e. Initial conditions (set point values)
- f. Modification (calibration reports, changes in set points, minor repairs, BAS modifications)
- g. Provide recommendations for system repairs, upgrades, and additional training
- h. Prioritization of recommended actions in accordance with CFR criteria (FIMs and EEMs)
- i. Conclusions

## **8. IMPLEMENTATION**

**8.1 Introduction.** The implementation of Owner authorized modifications is performed in a progressive process with low- and no-cost modifications occurring during the investigation phase, including system tune-up. Repairs

or adjustments are often required before further investigation of the systems and assemblies contained in the EBCx scope can be evaluated further.

## **8.2 Requirements**

### **8.2.1 Roles and Responsibilities**

#### **8.2.1.1 Owner**

- a. Provide repair budget to bring commissioned systems and assemblies within original design parameters, in-kind replacement, or designate systems or assemblies that no longer meet the CFR
- b. Identify issues that exceed the annual O&M budget that shall be included in future capital planning and progressively corrected until brought into compliance with the CFR
- c. Ensure O&M entity participation and collaboration with CxP Team and performs required repairs within approved EBCx Plan schedule
- d. Establish specific individual within Owner's organization to ensure benchmarking data is collected and analyzed
- e. Review benchmarking data at least annually and adjust O&M practices and expenditures to achieve annual CFR improvement goals

#### **8.2.1.2 CxP Team**

- a. Upon notification from the Owner that identified repairs impeding EBCx have been completed, the CxP Team shall reevaluate the system or assembly per the EBCx Plan and Cx scope included in the CFR
- b. Update field, test, and progress reports as EBCx work progresses and keeps the Owner informed of findings
- c. Maintain a current issues and resolution log and review with the Owner and obtains direction and approval are required from the Owner
- d. Verify benchmarking data is being collected and meets the CFR requirements. Report discrepancies or deficiencies in progress reports to the Owner

## **9. HAND-OFF**

### **9.1 Introduction**

- a. The hand-off phase is the transition between the EBCx Team and the Owner's O&M (operation and maintenance) entity responsible for operating and maintaining the facility for the Owner. The CxP provides the information obtained through the Cx activities that is documented in accordance with Section 5.2.1.3.2, "Systems Manual Development."
- b. The Systems Manual is the repository of information gathered and updated during the EBCx and the location where modifications were made after the EBCx by the O&M entity is documented along with the reasoning for the modification. The subsection of the Systems Manual known as the Facility Guide contains the current sequence of operation information and final set points established during the EBCx. The Systems Manual is used to conduct training of O&M staff, including the use and updating of the Systems Manual as modifications are made and modifications to the CFR are made to account for changes in building use and occupant mission.
- c. The Systems Manual shall contain all information gathered during the EBCx including lessons learned, procedures as appropriate for continuous improvement in achieving the CFR, and benchmarking procedures required by Section 5.2.1.2.1, "Development of Current Facility Requirements" to provide an ongoing basis to evaluate building performance.

### **9.2 Requirements**

#### **9.2.1 Roles and Responsibilities**

##### **9.2.1.1 Owner**

- a. Ensure O&M entity participation in training and use of Systems Manual

- b. Verify benchmarking parameters are being recorded for future evaluation of building performance
- c. Review benchmarking analysis at least annually and provide direction to O&M entity for continued improvement goals defined in the CFR
- d. Evaluate the advantages of implementing OCx

**9.2.1.2 CxP Team**

- a. Deliver Systems Manual and conduct training. Training shall include avoiding operation mistakes, modifications implemented, and associated reasoning associated with the modifications.
- b. Conduct lessons learned workshop/meeting
- c. Discuss Ongoing Cx and implementation of Ongoing Cx