[Client Name]

Building Name

Retro-Commissioning Plan

**Building Address:**

[Address]

[Address]

**Per the requirements of:**

[Company Name]

Building Owner or Property Manager

[Address]

[Address]

**Prepared by:**

[Company Name]

Retro-commissioning provider (CxP)

[Address]

[Address]

**Revision:**

 Version 1: MM/DD/YYYY

[Version 2: MM/DD/YYYY]

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# Retro-Cx Plan

This plan has been developed to guide a retro-commissioning (retro-Cx) process at the subject building. *Explanatory notes are included for reference. These notes are italicized throughout and can be deleted in the final Plan. The Plan is to be customized as appropriate for conditions specific to the property. Reference the Retro-Commissioning Scope of Work for additional information, including roles and responsibilities for involved parties.*

## Retro-Cx Program Goals and Objectives

The purpose of retro-Cx for this building or portfolio is to identify and implement cost effective, de-risked operating adjustments and measures to reduce energy use [and for applicable buildings potential BEPS fine exposure] without diminishing the occupant experience. *Include objectives as applicable to the project.*

1. Potentially reduce BEPS fine exposure. Buildings that are not compliant with BEPS may be subject to alternative compliance payments if significant energy reduction is not achieved. While significant additional work might ultimately be required to comply with BEPS, beginning with Retro-Cx can be a strategy to identify and assist in implementing energy efficiency and other measures.
2. Reduce energy spend with cost-effective interventions. There is a range of approaches to reduce energy use and cost. Retro-Cx measures can be compared, packaged, and iterated upon to design a set of measures that deliver the needed energy reduction at the lowest reasonable cost.
3. Maintain or improve current levels of occupant comfort. Some measures, if implemented, may increase cost. Measurements of occupant comfort will be taken into account through the process.
4. Document key operating parameters. One output of the retro-Cx process is compiled documentation of set points, schedules, and other facility requirements.

## Description of the process and key steps

Retro-Cx is a detailed assessment of major energy using equipment looking to align system operating conditions with facility requirements. This is considered a subset of “existing building commissioning.” One way to think about the purpose and approach is as a building tune-up. The phases or major elements of a retro-Cx process are identified in Table 1. Each phase is then described in greater detail.

*Table 1 Retro-Cx process*

|  |
| --- |
| **Phase 1 – Planning and Investigation** |
| Task1 – Planning |
| Task 2 – Investigation |
| **Phase 2 – Implementation and Turnover** |
| Task 3 – Implementation |
| Task 4 – Turnover  |

### Phase 1 – Planning and Implementation

**Task 1: Planning**

The following activities are part of the planning phase. The primary goal of the planning phase is to establish a set of criteria and test procedures to evaluate building performance. During the planning phase of the process, current facility requirements are assessed, the retro-Cx plan is established, test procedures are developed, and building documentation is reviewed.

#### Documentation Review

The following documents will be reviewed to inform the retro-Cx process. *Customize this list as applicable for the property.*

* Recent energy audit reports
* Testing, adjusting, and balancing (TAB) reports from recent construction or renovations
* Current stacking plan
* BMS trend data
* Preventive maintenance plans and installation, operation, and maintenance manuals
* Maintenance records
* As-built drawings, shop drawings, and equipment selections
* Other pertinent reports on system or equipment performance, service records, or studies

#### Current Facility Requirements (CFR)

Commissioning provider (CxP) will develop a draft CFR document. The CFR will include the building operating schedule, space temperature and humidity requirements, ventilation requirements, energy performance goals, maintenance schedule, list of required operator training, and other requirements applicable to the facility.

The client will review and annotate the draft CFR and return to the CxP for revisions. The client will approve the CFR for use as part of the retro-Cx process.

*Any facility-specific requirements should be identified in CFR*.

#### Energy Benchmark

ENERGY STAR Portfolio Manager is used by the facility for energy benchmarking, ESG reporting, and compliance with DC’s Energy Benchmarking and Disclosure and Building Energy Performance Standard regulations.

Real-time energy use data is typically collected by utilities for buildings with large electric service. Pepco, for example, typically makes this “Green Button Data” available online in each customer’s account dashboard.

Energy performance goals and requirements are included in the CFR for each facility.

#### Retro-Cx Plan

This is the retro-Cx plan. It is a document that describes the retro-Cx process, identifies major activities and responsible parties, lists the systems to be commissioned, notes the team communication plan, and includes test procedures to be implemented on various systems and equipment.

#### Trend Data Collection

The CxP will assess availability of existing trend data during the site visit scheduled alongside the building kickoff meeting or perform separate installation verification site visits depending on the complexity and size of the property.

There are a couple of options available to obtain trend data – *Customize this list as applicable for the property.*

* Access to previously stored data in building management system trend logs.
* Automated reporting of future trend log reports.
* Setup of trend definitions and reports to analyze data can be setup in collaboration with the controls contractor, but assistance with modifying or adding trend definitions and collection times may be required.

#### Functional Test Procedure Development

The CxP develops functional test procedures for systems and equipment included in the retro-Cx process. Procedures will include steps to collect and verify equipment nameplate data, assess the condition of equipment, verify accuracy and calibration of sensors and actuators, measure air and water flows, and test sequences of operation. The intent of the test procedures is to document equipment operation, identify opportunities to improve performance, and identify equipment that is not functioning as expected.

#### Site walks/kickoff meetings

* Portfolio-wide kickoff – hybrid/virtual meeting. *Include if applicable.*
* Building kickoff – in-person meeting on site.
* The CxP will facilitate meetings, write an agenda prior to each meeting, and compile minutes.
* Installation verification site visit(s). *The number and duration of the initial site visits will depend on the quantity and complexity of the systems to be commissioned.*

Deliverables

* Kickoff meeting agenda and minutes
* Current Facilities Requirements document
* Retro-Commissioning Plan
* Completed installation verification checklists
* Functional performance test procedures

**Task 2: Investigation**

The goal of the investigation phase is to inspect and test systems and equipment to develop actionable, implementable retro-Cx measures for the building management team to consider. During the investigation phase, retro-Cx provider team members will be on-site for three to four days (larger, more complex systems may require additional time) to conduct functional tests. At the end of the investigation phase, a preliminary retro-Cx report will be developed that summarizes key findings and documents the work performed to identify them.

The preliminary retro-Cx report will be presented to the project team. The CxP will facilitate a meeting with building management to review issues and measure packages.

#### Functional Testing

The CxP will complete testing of systems to be commissioned. The building operator will provide access to all equipment, building’s energy management system, and direct digital controller (DDC) systems *if applicable* in support of testing efforts.

Sampling will be pseudo-random. Where sampling will take place – i.e. with floor-by-floor air handling units or terminal units - the sample will be selected to test equipment on different parts of the system. Equipment with known issues will be selected at a higher rate than typical equipment.

Additional functional testing details can be found in the functional test templates and functional testing overview below.

##### Functional Testing Overview

Functional testing is a step-by-step exercise to document operating conditions and identify potential issues with systems and equipment. *Customize this list as applicable for the property.*

1. Installation checks (performed by CxP, access provided by building staff)
	1. Nameplate data collection and verification.
	2. Static quality issues – excessive corrosion, major leaks, vibration isolation.
	3. Required accessories and appurtenances are present, mounted, and secure.
	4. Typical preventive maintenance activities are up to date.
2. Sensor and device checks for process variables and points used in the sequence of operations (performed by CxP, access to equipment and DDC head-end provided by building staff)
	1. Verify operation of duct high static safety devices, if present.
	2. Verify operation of freeze protection safety devices, if present.
	3. Verify reading of temperature and humidity sensors against a calibrated handheld meter.
	4. Verify differential pressure sensors.
3. Flow measurements at prime movers (performed by CxP, access to equipment provided by building staff)
	1. Supply air
	2. Outside air
	3. Chilled water
	4. Condenser water
	5. Heating hot water
4. Sequence tests (performed by CxP, access to equipment provided by building staff) – This is the most interactive portion of the process. We recommend that operating staff observe or participate in this part of the testing process.)
	1. Set point verification
	2. Cooling mode
	3. Heating mode
	4. Humidity control modes
	5. Economizer mode
	6. Freeze protection mode
	7. Scheduled operation/optimal start
	8. Distribution pressure control – i.e. pump and fan speed control
5. Trend Review vs. Actual Tests: Some sequences like morning warm-up and duct static pressure trim and respond sequences are long acting and are better suited to verification through trend review as opposed to a discrete test.

#### Building Night Walks

The CxP will walk each facility during off-hours and survey central buildings systems and lighting controls that are on or otherwise not in unoccupied mode. A report will be generated identifying areas and systems that are operating when not expected along with recommendations for turning additional systems or equipment off. Each walk should take approximately one hour per building. *Optional. Adjust this scope for multifamily buildings or other buildings with 24/7 operations to account for appropriate time frames when systems would go into standby mode.*

#### Trend Data Analysis

Using the trend definitions established in the planning phase, the CxP will collate and analyze the trend data obtained. The trend review will identify potential opportunities to improve energy efficiency, reliability, thermal comfort, or other aspects of building system performance. Typical trend reviews look for schedule adherence, set points, simultaneous heating and cooling, valves leaking by, ventilation system operation, and economizer performance.

#### Issue Documentation

Where instances of non-functional, out-of-calibration, severely deteriorated, leaking, or other items considered deficient are encountered, the CxP will document such conditions as an issue. Each unique instance identified will be considered an issue.

Each issue will include the following information:

* Identification of the equipment or system
* Location of issue
* Description including a recommend path to resolution
* Photos, graphs, or other supporting documentation as appropriate
* Categorization
* Priority

#### Measure Development

Using good engineering judgment, experience with similar buildings, and approaches to system repair, renovation, and replacement, issues will be grouped into measures. Retro-Cx measures (RCMs) are similar to energy efficiency measures (EEMs). The purpose of RCM descriptions is to describe scopes of work, energy and non-energy benefits, an opinion of cost, and implementation considerations.

For measures to be recommended they must:

1. Have a five-year payback or better. (Simple payback, including incentives, excluding tax benefits, includes BEPS fine avoidance, where applicable.)
2. Support the BEPS compliance pathway for the property.
3. Align with long-term decarbonization goals. (E.g. no new fossil fuel combustion on-site.)
4. Have a neutral or positive impact on occupant comfort.

Different measures will be prioritized by considering the cost effectiveness (energy savings to implementation cost ratio), magnitude of impact, and amount of potential disruption to tenants.

#### Preliminary Report

At the conclusion of the investigation phase, a preliminary retro-Cx report will be assembled and delivered to the project team. The preliminary report will include the following sections:

1. Cover page and table of contents.
2. Retro-Cx measure list.
3. Issues log.
4. Test results.
5. Retro-Cx plan.
6. Current Facility Requirements document.
7. Test templates for future use.
8. Other supporting documentation as appropriate.

#### Site visits and meetings

* Functional testing site visits as defined in the scope of work.
* One meeting to present preliminary retro-commissioning report and corrective action/retro-commissioning measures.

Deliverables

* Functional performance test results
* Retro-commissioning issues log
* Retro-commissioning measures list
* Preliminary retro-commissioning report

### Phase 2 – Implementation and Turnover

*The specific engagement of the CxP for implementation and turnover is to be determined following completion of the planning and investigation phase as the scope is highly dependent on complexity of the measures being proposed for implementation and client capacity for project management and execution. The following Tasks listed here are examples of what is typically included in the retro-Cx Plan. Task 3 and 4 should be updated accordingly depending on the final scope.*

**Task 3: Implementation**

The specific engagement of the CxP is to be determined in the implementation phase. Implementation of retro-Cx typically includes the following activities:

#### Update Retro-Commissioning Plan

Update Retro-Commissioning Plan based on findings from Planning and Investigation phases to include specific implementation phase activities, an updated schedule, the list of measures selected for implementation, and the roles and responsibilities of the client, the commissioning provider, and other stakeholders.

#### Scoping

Facilitate one implementation kickoff meeting with project stakeholders. The meeting will take place in person at the building with a remote option. The CxP is also able to host the meeting at their office near the building. The CxP will develop an agenda prior to the meeting and provide summary notes following the meeting.

In collaboration with the building team, the CxP will confirm the selected measures for implementation.

Conduct outreach to potential vendors and service providers. The outreach will include an informational meeting or phone call, sharing relevant parts of the previously conducted study, and creating a written summary memorializing the outreach.

Update energy efficiency measures documented in the previously conducted energy assessment for potential contractors/suppliers to respond to.

#### Procurement Support / Bid Facilitation

Obtain proposals from potential vendors based on the updated retro-Cx measure descriptions. The CxP will facilitate one site walk in collaboration with property management for vendors to visit the site in preparing proposals.

Assist with bid questions by summarizing questions and responding to or facilitating the response to ten bid questions at most.

Summarize proposals received and provide leveled comparisons along with notes on qualifications where appropriate.

Provide consulting and advice to reach a go/no-go decision on each retro-Cx measure.

#### Oversight and Verification / Functional Testing

Facilitate one kickoff meeting with selected vendors, the client’s construction manager, and on-site property management. The CxP will develop an agenda prior to the meeting and provide summary notes following the meeting.

Collaborate with the controls contractor to setup trend definitions and monitoring to support verification of the selected measures. Using these trend definitions, the CxP will collect operating data required to establish monitoring and verification (M&V) baselines where applicable.

Conduct one review on submittals and shop drawings provided by vendors through the implementation process. Review comments will be provided to the contractor and the client.

Conduct up to four visits or eight hours for interactive troubleshooting assistance in the field with the selected vendors. *Update the number of visits as applicable for the property.*

Provide functional testing and verification of implemented measures. Based on the measures previously discussed, two days or 16 person-hours of functional testing is expected. Test procedures will be revised based on the measures selected for implementation. Results of the tests will be documented and shared with the project team. Depending on the CxP will log deficiencies and recommended steps to resolution. *Update the number of visits as applicable for the property.*

Develop an Implementation Report documenting the work performed, expected energy impact, and issues encountered.

#### Site visits and meetings

*Meetings and site visits will vary depending on the measure being implemented and the implementation assistance required. Reference retro-Cx scope of work for examples.*

#### Deliverables

*Deliverables for this phase will vary depending on the measure being implemented and the implementation assistance required. Reference retro-Cx scope of work for examples.*

**Task 4: Turnover**

The specific engagement of the CxP is to be determined during the turnover phase. Project turnover of the retro-Cx implementation work typically includes the following activities:

#### Turnover Package

Assemble turnover package including IOMs, shop drawings, warranties, points of contact for service, spare parts where applicable, and ongoing maintenance contracts scopes where applicable.

A systems manual, if included in final scope, will typically include the following:

* As-built drawings and construction records like shop drawings and product data.
* Sequences of operation.
* Set points.
* Schedules.
* Equipment manuals.
* Equipment and system test records (e.g. testing, adjusting, balancing (TAB), infrared (IR) scans, water quality reports, etc.).
* template test procedures for future use.
* Maintenance schedules and procedures.
* Commissioning records from tenant improvements and refits.
* Contact information for contractors and service providers.

Updated CFR as applicable for buildings where new equipment was installed and commissioned during Implementation phase. Incorporate relevant components of this turnover package in the updated CFR.

*Customize the above list as applicable for the property and in accordance with ASHRAE Guideline 1.4-2019.*

#### Turnover Meeting

Facilitate one turnover meeting with project stakeholders. The purpose of this meeting is to review the status of each RCM, verify resolution of issues encountered during the installation process, train operating staff on the new equipment, features, and sequences as appropriate, and delivery of the turnover package. The CxP will develop an agenda prior to the meeting and provide summary notes following the meeting.

#### Training

The CxP will provide and document training on new and modified systems. The training will include a review of the concept of operations for new and modified systems, a review of the systems manual with operations and maintenance staff, and a review and demonstration of any new or changed preventive maintenance procedures. The training will be video recorded, and handouts, manuals, and logs added to the facility’s system manual.

#### Ongoing Commissioning Plan

The CxP will develop and provide the client with a plan to ensure that performance improvements realized from the retro-Cx process persist over time. The ongoing commissioning plan will identify roles and responsibilities, key performance indicators, how data will be collected, and a corrective action process. *Reference the scope of work for more information.*

#### Monitoring

Monitor measures for persistence and energy savings for six months. Every three months, the CxP will pull trend data from the building’s DDC system and review the available energy data. The monitoring and verification (M&V)) report will identify actual energy savings compared to predicted, progress towards BEPS compliance, and issues identified through trend review along with recommended next steps.

##### M&V Approach

For buildings already in compliance with the BEPS requirements or on the standard target pathway, ENERGY STAR score will be the key performance indicator.

For buildings on the performance pathway, site EUI adjusted to current year will be used as the key performance indicator.

While system-specific key performance indicators (KPIs) might be preferable to whole building energy use, it may not be worth the effort to develop and implement those KPIs. The CxP will select specific KPIs to analyze and include in the M&V report.

Examples of system specific KPIs include:

1. Chiller Plant COP
2. Ventilation
	1. ASHRAE 62.1 Ventilation Rate Procedure (VRP) approach.
	2. Difference from design approach – measured outside air flow matches design requirements + CO2 levels.
	3. Benchmark flowrate per SF.
3. Hours of plant operation outside lease time

#### Lessons Learned Workshop

Facilitate, participate in, and document a Lessons Learned workshop. The purpose of this session is to identify and discuss aspects of the process that was done well, that did not work, and those that should be done differently in the future.

#### Final Retro-Cx Report

Develop a Final Retro-Cx Report that documents and memorializes the process undertaken to include a high-level summary of measures implemented and a detailed compilation of test data, observations, and other material generated because of the commissioning effort.

#### Site visits and meetings

*Meetings and site visits will vary depending on final scope for turnover. Customize this list as applicable for the property.*

* 2 person-days of training on site
* 1 lessons-learned meeting
* 1 final retro-commissioning report review meeting

Deliverables

* Training sign-in sheets, agendas, and recordings
* Systems manual
* Updated retro-commissioning issues log
* Final retro-commissioning report including lessons learned meeting read-out, updated retro-commissioning issues log, and list of implemented retro-commissioning measures.

## Building and Facility Details

### Systems to be Tested

This is a general list of systems to be tested. Not all systems may be present in every building. *Customize this list as applicable for the property.*

* Central HVAC systems
	+ Building management system
	+ Chilled water plants
	+ Central station air handling units
	+ Central station air handling units with energy recovery
	+ Commercial condenser water systems
	+ Modular air handling units
* Central plumbing systems
	+ Domestic water booster pump
	+ Hot water systems
* Terminal equipment
	+ Single-duct shutoff VAV terminal units
	+ Single-duct series fan-powered
	+ Riser fan-coil units
	+ Chilled water induction units
	+ Electric baseboard heat
* Unitary equipment
	+ Split system heat pumps
	+ Packaged RTUs
* Lighting control systems
	+ Controls to automatically turn lights off overnight.
		- Interior
		- Exterior
* Commercial Kitchens
* Distributed Energy Resources (DERs)
	+ Solar
* Building Envelope
	+ Roof
	+ Ductwork
	+ Insulation
	+ Shading
	+ Windows

## Communication

### Project Team Information

|  |  |  |  |
| --- | --- | --- | --- |
| **Role** | **Name** | **Company** | **Contact Info** |
| **Ownership**  |  |  |  |
| **Building Engineers** |  |  |  |
| **Controls Service Provider** |  |  |  |
| **Commissioning Provider** |  |  |  |

## Schedule

|  |  |
| --- | --- |
| **Milestone** | **Estimated Date of Completion** |
| Kickoff Meeting |  |
| Testing Dates |  |
| Trend Review |  |
| Issues Log |  |
| Retro-Cx Measures List |  |
| Preliminary Retro-Cx Reports |  |
| Presentation of Retro-Cx Findings  |  |
| Transition to Implementation (and define new milestones) |  |
| CY 2023 Energy Benchmarking with Third Party Verification  | July 1, 2024 |
| CY 2024 Energy Benchmarking  | April 1, 2025 |
| CY 2025 Energy Benchmarking  | April 1, 2026 |
| BEPS Cycle 1 Evaluation Year  | January 1, 2026, to December 31, 2026 |
| CY 2026 Energy Benchmarking  | April 1, 2027 |