

Appendix P-5a: Operations Commissioning Supporting Information

Introduction

Operations Commissioning shall be planned for during design, but focuses on the operations of the facility after construction through the next use of the facility. The Operations Commissioning process is the means to verify and document that the systems of a facility and the facility as a whole continue to operate in accordance with their design intent overtime. This includes planning, implementation, and documentation for regular preventative maintenance, Measurement and Verification of system and whole building performance, and improvement and correction of that performance. The Operations Commissioning process is coordinated by the Operations Commissioning Leader and executed by the Operations Commissioning Team. Initial operations input are provided by the participation of the Facility Operations Manager on the Design and Construction Commissioning Team.

Later in design, the Operations Commissioning Team is formed and leads the planning for Operations Commissioning after occupancy.

The following are narrative descriptions of the activities (rows) in the Operations Commissioning Matrix.

1. GENERAL

1.01 Evaluate Existing Facility Operations

Evaluate existing facility operations to provide a reference point of operating issues for use in planning operation of the future facility or the existing renovated facility. Note that all existing state buildings must participate in the B3 Benchmarking Database.

1.02 Participate on Design & Construction Commissioning Team

Identify a Facility Operations Manager (FOM) who will manage maintenance and operations of the facility, be responsible for understanding Operations and Maintenance manuals, and monitor and report ongoing performance of the facility. The FOM should participate throughout the design process for continuity into final operation.

This person shall be part of the Design and Construction Commissioning Team and work closely with the Guideline Leader during design phases. The FOM shall represent operations issues from the beginning of the Design and Construction Commissioning Process and shall also be part of the Operations Commissioning Team once it is formed.

1.03 Engage Operations Commissioning Team

Identify Leader and Members of the Operations Commissioning Team during the Design Development phase of the design and construction project. The team shall be comprised of the following individuals, plus any added expertise needed for specific building systems.

Facilities Operations Manager (FOM) is accountable for facility performance and manages or performs ongoing operational practices, maintenance and corrective actions. FOM may also fill the role of Guideline Leader during ongoing occupancy phases.

The person from the Operations Work Team who will be in charge of compliance with the Guidelines during Ongoing Occupancy (Guideline Leader if applicable to Agency Process). This person will document

ongoing management, maintenance and correction actions, and complete annual and interim reporting as per the Outcome Documentation Forms.

1.04 Operations Commissioning Plan

The Operations Commissioning Plan shall include directly or by reference provision for all items required in the Commissioning Guideline P.5 for planning, implementing, or documenting activities from Correction Period through the life of the project. The Operations Commissioning Plan includes by reference the following documents that may be packaged separately but shall be coordinated with all other parts of the Operations Commissioning Plan.

- Systems Turnover Process (from Construction to Operations)
- Operations and Maintenance Manuals (O&M Manuals as per conventional contracts)
- Problem Response Plan
- Maintenance Plan
- Measurement and Verification Plan
- Systems Operations Manual
- Funding and Staffing Plan

The Operations Commissioning Plan shall evolve as follows:

Design Development Phase

Operations Commissioning Plan shall be outlined during a project's Design Development Phase; a time when operations issues shall be coordinated with design and construction issues.

Review and participate in coordination of the Operations Commissioning Plan and the Design and Construction Commissioning Plan

Construction Documents Phase

A complete Operations Commissioning Plan shall be developed during the Construction Documents phase of the design and construction project in cooperation with the Design and Construction Commissioning Team.

Correction Phase

The Operations Commissioning Plan shall be finalized during the Correction Period when all technical details of the building systems are known.

The Facilities Operations Manager (FOM) participates in the development and review of the Operations Commissioning Plan. FOM submits a funding and staffing plan that outlines the FOM's methodology to fund and staff all aspects of the Operations Commissioning Plan.

1.05 Annual Operations Commissioning Review & Plan Update

During On-going Operations, review all aspects of the Operations Commissioning Plan at least annually. Update the Plan as needed to reflect changes in equipment or practices.

The FOM updates the facility's operations budget and staffing as required to continue the implementation of the Operations Commissioning Plan based on updates to the Operations Commissioning Plan and changes to the equipment, systems, or operations.

1.06 Annual Operations Commissioning Report

The Operations Commissioning Report is an evaluation of work at a particular point in time in comparison with the Commissioning Plan. After the correction period, complete an Operations Commissioning Report that documents monitored usage and other data, and includes a log of actions taken to address aberrations or problems.

1.07 New Employee Training Program

Orient new members of the facility's operations and maintenance management and staff to the building system documentation and the Operations Commissioning Plan. All staff shall be familiar, at a level appropriate with their responsibilities, with the history and upkeep of project records and their contents from review of prior phases of the Operations Commissioning Plan and its supporting documents.

1.08 Submit Outcome Documentation

Submit Outcome Documentation in the B3 Guidelines Tracking Tool (trackingtool.b3mn.org) as required by the B3 Guidelines at the end of each phase of the design and construction process and throughout the on-going operations phase.

1.09 Next Use

Provide transition data, history, requirements and Guideline plans and reports to new owner and facility manager. Encourage the new owner to proactively support the Guidelines.

2. SYSTEM TURNOVER PROCESS FROM CONSTRUCTION TO OPERATIONS

2.01 Define Turnover Prerequisites

Define the minimum level of completeness and/or performance required prior to the formal transfer of responsibility from the construction team (contractors) to the operations team (owner). These prerequisites must be objective and enforceable and communicated clearly to the Design and Construction team for inclusion in the bid documents.

2.02 Define Authority for Official Acceptance and Turnover

Define exactly who, typically someone representing the Owner, will have final approval authority for the transfer of the systems from the contractors to the owner.

2.03 Operations Team Familiarization with Project Documentation and Systems

Prepare and follow a schedule for preparing operations and maintenance individuals to take over the building systems. This familiarization should be complete prior to the official turnover:

- Identify the future operations team members and make them available for turnover preparation activities.
- Allow the future operations team members to walk through the construction site as frequently as practical, especially prior to wall and ceiling close-in.
- Introduce the future operations team members to the construction documents and operations & maintenance manuals.
- The future operations team members shall attend the formal equipment and systems training sessions provided by the installing contractors.
- Conduct formal question and answer sessions with the future operations team and the designers and contractors to address remaining questions and concerns prior to turnover.

- Introduce the future operations team members to the Problem Response Plan (refer to Section 3), Maintenance Plan (Section 4), and Energy Efficient Operations Manual (Section 5) components.

2.04 Complete Systems Transfer from Contractors to Operators

Systems shall be turned over to the operations team either all at once or on a pre-defined piecemeal basis. However, once a system is turned over to the owner, the contractors shall obtain permission and provide full documentation for all work performed on any turned-over system.

3. PROBLEM RESPONSE PLAN

The Problem Response Plan is part of the Operations Commissioning Plan and shall cover the systems and materials commissioned under Operations Commissioning Scope. Key components of the Plan are clear assignments of responsibility to individuals and defined lines of communication. Incorporate a planned response to anticipated feedback or triggers indicating potential performance problems such as an increase in IEQ complaints or aberrations in monitored resource use. This includes problems discovered by the Operations Staff as they implement their Work Order Verifications as defined in Section 5.11: Facility Work Order Verifications of this Appendix.

If the project is part of a campus (e.g., under the ownership or management of a single entity such as a corporation, government, college or university), the equipment and/or systems defined under the project shall follow the Problem Response Plan requirements.

Typically, campus-style facilities employ a comprehensive computerized maintenance management systems (CMMS) which manages and documents the campus equipment and systems' preventive maintenance schedules, troubleshooting calls, work orders, etc. If the Problem Response Plan components listed below (3.01 through 3.05) are not covered, they shall be incorporated into and/or supplement the existing campus-wide operations and maintenance program.

If the Problem Response Plan components are already included in the campus-wide operations and maintenance program, the Contractor shall document how each component is addressed for the pre-defined acceptance authority. If there are Problem Response Plan components not included in the existing campus-wide operations and maintenance program, the Contractor shall describe how each such component will be addressed and implemented. This documentation shall be provided to the pre-defined acceptance authority for review and approval (refer to Section 2.02 above).

3.01 Problem Documentation Process

Define a process by which problems are documented and passed on to the appropriate party for attention.

3.02 Problem Response Process

Predefine potential problem responses for use in timely and comprehensive management of each documented problem. Responses may include fixing or replacing broken components (including correction work by installing contractors), recalibrating control devices, performing functional performance tests to help identify the root cause of a problem, redesigning a system that no longer meets the changing needs of the occupants, etc.

3.03 Problem Resolution Documentation Process

The Problem Response Plan process shall include a feedback loop for positive closure.

3.04 Implementation

Implement the Problem Response Plan immediately upon turnover from the contractors to the operations team. Clearly define lines of communication with the installing contractors for correction phase activities. The operations team must be in control of and/or aware of all activities associated with the systems following turnover.

3.05 Annual Evaluation and Reporting

Each problem and its resolution shall be logged for incorporation into the annual Operations Commissioning Report.

4. MAINTENANCE PLAN

The Maintenance Plan is part of the Operations Commissioning Plan and shall apply to all systems and materials commissioned under the Operations Commissioning Scope.

If the project is part of a campus (e.g., under the ownership or management of a single entity such as a corporation, government, college or university), the equipment and/or systems defined under the project shall follow the Maintenance Plan requirements.

Typically, campus-style facilities currently employ comprehensive computerized maintenance management systems (CMMS) which manage and document the campus equipment and systems' preventive maintenance schedules, troubleshooting calls, work orders, etc. If the Maintenance Plan components listed below (4.01 through 4.11) are not covered, they shall be incorporated into and/or supplement the existing campus-wide operations and maintenance program.

If the Maintenance Plan components are already included in the campus-wide operations and maintenance program, document how each component is addressed for the pre-defined acceptance authority. If there are Maintenance Plan components that are not included in the existing campus-wide operations and maintenance program, the Contractor shall describe how each such component will be addressed and implemented. This documentation shall be provided to the pre-defined acceptance authority for review and approval (refer to Section 2.02 above).

4.01 Cleaning Products and Practices

Use ISO 14000 requirements for cleaning supplies in standard maintenance after building occupancy.

4.02 Cleaning Products Documentation

Document all cleaning products used and quantities of each for inclusion in the annual Operations Commissioning Report.

4.03 Moisture Prevention Practices

Establish maintenance procedures that will identify unintended water intrusion, leakage or accumulation quickly and provide drying or removal of building structure elements within 48 hours of the unintended event.

4.04 Moisture Response Practices

When exterior water intrusion, leakage from interior water sources, or other uncontrolled accumulation of water occurs, the intrusion, leakage or accumulation shall be corrected because of potential for these

conditions to cause the growth of mold. (Title 8, Chapter 4, Section 3362(g) of California Occupational Safety and Health Standards, Sept. 2002.)

4.05 Moisture Control Documentation

Document all moisture intrusion events and their resolution for inclusion in the annual Operations Commissioning Report.

4.06 Preventive Maintenance Activities

Implement a preventive maintenance program for IAQ and other Indoor Environmental Quality factors in the building. The preventive maintenance plan shall include regularly scheduled checks to verify ongoing performance and to prevent failures of the facility and its systems, including verification of selected system performance compared to their respective Expected Performance Graph-Diagnostic Diagrams (refer to 6.10 and 6.11 below). This can be modeled after EPA's Building Air Quality Program (1991) or their web-based system called I-BEAM (IAQ building education and assessment).

4.07 Preventive Maintenance Documentation

Document the preventive maintenance program, inventory of equipment, and scheduled work orders in the Operations Commissioning Plan. Log all completed preventive maintenance activities for inclusion in the annual Operations Commissioning Report.

4.08 Implementation

Implement the Preventive Maintenance Plan immediately upon turnover from the contractors to the operations team. During the correction phase of the project, it is critical that required preventive maintenance be performed in order to maintain the validity of equipment manufacturers' warranties.

4.09 Annual Building IAQ Performance Evaluation

Perform an evaluation of building IAQ performance annually. Measure key factor that determines ventilation rate for the building (major pollutant or CO₂) in the building occupied zones. Pollutant concentrations measured should be within the guideline range, and CO₂ levels should be at or below 450 ppm over outdoor levels. If not, additional ventilation must be provided or sources eliminated until concentrations fall below action levels. Action values for each pollutant are given in Appendix I-0.

4.10 Annual Evaluation and Reporting

Facilities Operations Manager reviews the results of Indoor Environmental Quality management practices and highlights any issues needing resolutions. If, in the judgment of the Facilities Operations Manager, a severe or repeated complaint occurs, the Facilities Operations Manager will arrange for an investigation of the situation, and recommend corrective action if appropriate.

Annually, evaluate the following Systems Operations and Maintenance Practices in comparison to the Maintenance Plan portion of the Operations Commissioning Plan. Document findings and correct maintenance and operations practices, or update the Plan to reflect changes in practices.

- Site Systems
- Water Systems
- Energy Systems
- IEQ Systems
- Materials and Waste Systems

5. ENERGY EFFICIENT OPERATIONS MANUAL (RECOMMENDED/IN DEVELOPMENT)

The Energy Efficient Operations Manual is part of the Operations Commissioning Plan and documents important reference information for operating building systems. Tools supporting the processes outlined here are in development; please check the Operations Program details at www.b3mn.org/operations for current information. This section of the Operations process shall occur at regular intervals, or in response to other events or triggers at the discretion of the owner, to evaluate the following:

- Mechanical HVAC Comfort and Renewable Energy Systems: As needed to support performance of Guidelines: E.1, E.2, E.3, E.4, I.4, I.5
- Electrical Systems, including Lighting and Daylighting Controls: As needed to support performance of Guidelines: S.5, E.1, E.2, E.3, I.6, I.9
- Indoor Air Quality Elements and Systems: As needed to support performance of Guidelines: I.1, I.2, I.3, I.4, I.5
- The Systems Operations Manual shall include the following elements:

5.01 System Descriptions

Owner's performance requirements, design basis narratives, descriptions of each system, etc.

5.02 As Built Control Drawings and Sequences of Operation

As built control system documentation is typically obtained from the control system contractor following commissioning and acceptance of the systems at the end of project construction.

5.03 Time of Day Schedules and Plan for Assessing their Relevance

Document initial time of day schedules for each piece of controlled equipment. Based on building occupancy and usage, determine if and how often these schedules should be re-evaluated for minimum run times. Program those re-evaluations into the Preventive Maintenance system for automatic reminders.

5.04 Seasonal Considerations

Seasonal startup and shutdown, manual and restart operation procedures, and recommendations regarding seasonal issues that affect energy use. Program seasonal activities into the Preventive Maintenance system.

5.05 Recalibration Schedule

Recommended recalibration frequency for each sensor and device type. Program recalibration of each sensor and device into the Preventive Maintenance system.

5.06 Adjustable Setpoints and Plan for Assessing their Relevance

List of adjustable setpoints and reset schedules. Based on building requirements and performance under actual occupied loads, regularly evaluate the appropriateness of each setpoint for meeting with owner's requirements while minimizing energy consumption. Program those re-evaluations into the Preventive Maintenance system for automatic reminders.

5.07 Recommissioning Tests

Schedule for testing systems with procedures used in initial commissioning process. Program recommissioning tests into the Preventive Maintenance system.

5.08 Allocation of Building Energy

The initial allocation of building energy diagrams shall estimate the building’s annual energy consumption by type (e.g., natural gas, steam, chilled water, electricity, etc.). Furthermore, the estimated annual building energy consumption data should be broken down graphically into their respective energy consuming systems (e.g., heating, cooling, lighting, plug loads, etc.). The allocation of building energy diagrams shall be developed by the Energy Modeler during the design phase. For additional Sustainable Building 2030 requirements, refer to the Sustainable Building 2030 Compliance and Reporting Instructions.

5.09 Energy System Diagrams

Based on the allocation of building energy, develop energy system diagrams for systems that consume large amounts of energy, operate continuously, and/or are leading to excessive energy consumption. The development of the energy system diagrams shall be a joint effort between the Controls Contractor and the Commissioning Leader; where the Commissioning Leader is ultimately responsible for the development of the energy system diagrams. The energy system diagrams shall be developed and completed shortly after the approval of submittals during the construction documents phase.

During the on-going operations phase, additional energy system diagrams and/or updates shall be incorporated into existing Systems Operation Manual as equipment is added or removed to the building. Future energy system diagrams shall be developed and/or updated by the involved Controls Contractor and/or Commissioning Leader (if applicable).

5.10 Expected Performance Graph-Diagnostic Diagrams

Develop expected performance graph-diagnostic diagrams for each system that merited an energy system diagram. The expected performance graph-diagnostic diagrams illustrate how systems should operate based on their design and approved sequence of operation. These will be used as tools by the Operations Staff to determine if the systems and/or equipment are operating optimally. The expected performance graph-diagnostic diagrams shall be developed by the Commissioning Leader with input from the Designers shortly after the approval of submittals during the construction documents phase.

During the on-going operations phase, additional expected performance graph-diagnostic diagrams and/or updates shall be incorporated into existing Systems Operation Manual as equipment is added or removed to the building. Future expected performance graph-diagnostic diagrams shall be developed and/or updated by the involved Commissioning Leader.

5.11 Facility Work Order Verification Documents

Create facility work order verification documents where data (e.g., temperatures, equipment status, schedules, etc.) will be collected by the Operations Staff at periodic intervals while the facility is operational and occupied. On a regular basis, the Operations Staff shall compare the facility work order verification data to the expected performance graph-diagnostic diagrams in order to determine if the systems and/or equipment are using more energy than necessary. Deviations will be tracked through the Problem Response Plan process to identify the root cause and to determine the actions necessary to improve or remedy operational issues. Refer to Section 3: Problem Response Plan of this Appendix.

The facility work order verification “template” documents shall be created by the Commissioning Leader prior to substantial completion so they can be incorporated into the Maintenance Plan.

During the on-going operations phase, additional facility work order verification “template” documents and/or updates shall be incorporated into the Systems Operation Manual as equipment is added or

removed to the building. Future facility work order verification documents shall be developed and/or updated by the involved Commissioning Leader. If commissioning is not part of the equipment updates, the Designer and Contractors shall assist in the facility work order verification “template” document development and/or updates.

5.12 Implementation

Implement the systems operational evaluation/recommissioning process immediately upon turnover from the contractors to the operations team. During the correction phase of the project, the systems operational evaluation/recommissioning process and data will help identify any previously undiscovered aberrations in the system design, installation, and/or startup. It will also help to identify equipment failures within their respective correction periods.

5.13 Annual Evaluation and Reporting

The Facility Operations Manager (FOM) shall review the results of the systems operations evaluation/recommissioning process. Are verification work orders being completed on a timely basis? Are anomalies being documented and corrected? Is the documentation complete and orderly? If, in the judgment of the FOM, a severe or repeated problem occurs, the FOM will arrange for an investigation of the situation and recommend corrective action if appropriate.

Annually evaluate the systems operations evaluation/recommissioning process itself in comparison to the Systems Operations Manual portion of the Operations Commissioning Plan. Document concerns and correct or update the Systems Operations Manual to reflect changes in practices.

6. POST OCCUPANCY EVALUATION

6.01 Begin B3 Post Occupancy Evaluation (POE) Process

There are three (3) levels of sustainable POE surveys to choose from: “Scan, Core, and Advanced.” The required “Scan” survey is available for select building types and is free for State Funded B3 Guideline required projects. Complete details can be found at www.b3mn.org/poe/. Buildings with space types with no supported SPOES at 6 months post-occupancy (3 months prior to the first required POE) are exempt from this requirement. Projects may also be exempt if they do not meet the minimum required number of occupants or residents; more details on applicability are available at the B3 POE website.

The goal of these evaluations is to standardize the methodology for studying building’s performance from the occupant’s points of view, to provide feedback to the owners and operators, and understand how the building performs in practice.

Identify the facility or organization primary contact for the survey collection process and which tool will be used.

“Scan” Survey Level Details (Required)

- Measures “vital signs” of occupant perceptions
- Useful for quick evaluation of human outcomes related to sustainable criteria
- Limited diagnostic potential
- Tool and analysis is free of charge for State Funded B3 Projects

“Core” Survey Level Details

- Includes “Scan” survey level plus additional details about specific IEQ issues and locations

- Allows more analysis to show relationships between results
- Evaluative information plus a diagnostic screening tool
- Fee associated “Core” survey level

“Advanced” Survey Level Details

- Includes “Scan” and “Core” plus other areas owner or research interest
- Custom analyses also possible
- Draws added questions from master menu or unique to survey
- Fee associated with “Advanced” survey level

After the required surveys during the correction period, the FOM shall perform or coordinate completion of optional post-occupancy evaluation when organizational or productivity issues arise or at regular intervals.

6.02 Nine Month Sustainable Post Occupancy Survey (SPOES)

Nine months into the Correction Period conduct the first User Comfort & Satisfaction Survey as defined in the Assessment Plan.

6.03 Eighteen Month Sustainable Post Occupancy Survey (SPOES)

Eighteen months into the Correction Period conduct the second User Comfort & Satisfaction Survey as defined in the Assessment Plan.