COMMISSIONING GUIDELINES FOR CAPITAL PROJECTS

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES

CAPITAL PROGRAMS

CONTENTS

SECTION 1 - INTRODUCTION

About this Guide

This Commissioning Guide presents the framework for a commissioning process that complements the DGS Project Delivery System from Pre-Design phase through Project Closeout. The Guide defines commissioning roles and responsibilities for all members of the project team and describes the deliverables, acceptance criteria, processes and best practices required to perform commissioning on DGS Capital Projects.

The intended audience of the Guide are all capital project team members including Client Agencies, Commissioning Agents (CxA), Professionals, Contractors, and DGS Capital Programs personnel.

Commissioning, as defined in this guide, refers to a systematic process that is developed and executed to ensure that select systems and components of a building are designed, installed, tested, operated, documented, and maintained to best meet the operational requirements of DGS and/or the Client Agency. Commissioning can be applied to new construction and major renovation projects. Certain systems are required to be commissioned by code; additional systems may be commissioned at the Department's option.

This guide is written from the perspective of using third-party commissioning agents, contracted directly with the Department. Commissioning scope may also be performed by the Professional at the discretion of the Department. In such cases, the Department requires that the Professional provide independent commissioning staff separate from the design team to perform the requested additional services tasks. The procedures outlined in this guide are adjusted by the project team, so services accomplish the commissioning intent.

References

The DGS commissioning program incorporates best practices from several well-developed published resources. These resources identify proven methods to facilitate project constructability, enhance system maintainability, and deliver long-term value to end users. References are identified where appropriate in the program documentation and include documents from the following organizations:

- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
- American Society of Testing and Materials (ASTM) International
- Building Industry Consulting Service International (BICSI)
- International Electrical Testing Association (NETA)
- International Energy Conservation Code (IECC)
- International Society of Automation (ISA)
- National Fire Protection Association (NFPA)
- National Institute of Building Sciences (NIBS)
- Underwriters Laboratories (UL)
- U.S. Department of Energy (USDOE)

SECTION 2 – PROGRAM OVERVIEW

Invitation to Qualify (ITQ) Contract

The Department maintains ITQ contracts with pre-qualified commissioning agents to obtain commissioning services on all Commonwealth Capital projects. These contracts are no cost award contracts. Pre-qualified Contractors must respond to Requests for Quotes and be selected to perform commissioning services for each project.

The Decision to Add Commissioning to a Project

A decision is made during the Project Development Study about whether and how commissioning will be provided; the options include:

- A 3rd party CxA will be hired
- The Professional will be tasked with independent commissioning
- Commissioning is not required (Reference "Commissioning Requirements" by ASHRAE or IECC)

As previously noted, this guide is written from the perspective that DGS will hire a 3rd party CxA to perform commissioning services. If other commissioning arrangements are made, the project team should adopt procedures to accomplish the intent of this guide.

During Pre-Design, DGS can hire a 3rd party CxA to assist with preparation of the PDS, determine project system requirements, or conduct energy audits for existing facilities. This option may be ideal when the energy performance of an existing facility is not well understood, or the project is unusually complex.

DGS most often hires 3rd party CxAs at the beginning of the Design Phase. This allows the CxA to be fully involved in the design process and sets the project up for successful commissioning during construction.

Under unusual circumstances, DGS may hire a 3rd party CxA at the beginning of construction to execute an existing commissioning plan. This may occur if a CxA has participated in the design but is not being retained to perform construction services. This can also occur if the project team elects to add commissioning services to a project that does not yet include them. This late Cx addition is not ideal as it likely will require change orders to construction contracts to add commissioning scope.

The Role of the Commissioning Agent

The Department hires a commissioning agent to ensure that building systems are designed, installed, tested, and function according to the project requirements, manufacturer's instructions, and industry standards. The commissioning agent will act as an independent advocate for the Department, verifying that systems meet the intended design and operational goals.

Commissioning agents inspect product installation, develop, and oversee the testing and validation processes, identify and resolve deficiencies, and collaborate with the project team to optimize system performance. Additionally, they verify proper documentation, and training is provided for the Client Agency's use. These processes when correctly performed have been proven to contribute to the long-term reliability and efficiency of systems.

The Department expects all commissioning agents to demonstrate a high level of technical expertise, ensuring systems are designed and installed according to project documentation. Strong project management skills are essential to coordinate tasks efficiently, meet deadlines, and manage resources effectively. Collaboration and communication are critical in working alongside Professionals, Contractors, and other stakeholders to ensure project success. A focus on quality assurance is necessary to ensure that all work is inspected and meets the manufacturer's installation requirements. Commissioning agents should have a commitment to continuous improvement, seeking innovative solutions and best practices to enhance system performance and project outcomes.

Overall, commissioning aims to deliver a project that meets or exceeds DGS and the Client Agency expectations, increasing the reliability, efficiency, and maintainability of the building or plant systems.

SECTION 3 – THE COMMISSIONING PROCESS

The following is a description of the services that may be requested of a CxA by the Department. The scope of services is defined for each project in the Request for Quote (RFQ). Each scope item is accompanied by a defined deliverable which the CxA will post to Trimble. This allows the project team to evaluate CxA progress by reporting and verification of deliverables.

Pre-Design Phase

The Pre-Design Phase starts with the signing of a Project Charter and ends when the Department and the Design Professional endorse the Professional Agreement.

During Pre-Design Phase the Commissioning activities include energy audits and participating in the Project Development Study.

Conduct Energy Audit

An energy audit is an inspection, survey, and analysis of energy flows into and out of a building. These activities are performed to identify energy savings opportunities and improvements to a building or building system.

The Department conducts energy audits during the Pre-Design Phase to identify energy-related requirements and potential improvements when the energy performance of existing buildings is unknown or not well understood. The list of improvements and energy savings is useful to prioritize improvements when defining and validating the project scope of work during the Project Development Study.

Depending on the requirements of the project, DGS may request Commissioning Agents provide one of the following types of energy audits during the Pre-Design or early Design Phase:

- **Summary Audit** - The Summary Audit provides a rough estimate of energy saving opportunities used to prioritize whether a more detailed analysis is required. This is ideal when the project team is seeking a quick overview without deep investment in time or resources.

  The Summary Audit provides a basic, initial assessment of a facility's energy use. It involves a walk-through of the facility to identify obvious areas of energy waste or inefficiency and consists of a relatively brief inspection of the facility to identify maintenance, operation, or malfunctioning device issues. The Summary Audit should identify areas which need further evaluation.

- **Comprehensive Audit -** The Comprehensive Audit includes an evaluation and analysis of the energy consuming systems of the building in much greater detail. This type of audit is best suited for projects that desire major energy efficiency upgrades and/or would like to pursue LEED certification.

The Comprehensive Audit may include performing specific monitoring, metering, or testing to identify actual energy consumption and losses. It also consists of an economic evaluation of the identified opportunities, including comparative cost, benefit, and payback periods. The findings and

recommendations of this type of audit need to be presented in adequate detail to help the project team develop the project scope.

Key Activities

- Kick-off meeting: The audit begins with a kick-off meeting, preferably held onsite. During this meeting the auditor is provided with facility information including, at a minimum, existing drawings, O&M manuals, and energy usage information such as several years of utility bills. The auditor should walk through the facility with the Department and Client Agency representatives. The auditor should lead a group discussion to gather more information about processes, energy usage, and upgrade plans for the facility.
- Understanding the site and gathering the data: The auditor will evaluate the information provided and develop a plan to conduct the audit. This plan will describe audit activities, a schedule, and additional information which is needed. Employing well-written questionnaires, conducting site visits, and performing testing should provide the auditor with a clear understanding of the existing facility operating conditions. A critical success factor while planning the audit is to ensure the necessary people are aware of the audit and available.
- On-site inspection(s): This step consists of making site visits to verify that installed systems match the information provided. The inspections should be conducted to help the auditor understand system operations and how energy is consumed. The final on-site inspection should be closed by a wrap-up meeting with the same attendees as the kick-off meeting to announce the initial findings of the inspection and establish agreement on the report deliverables content and a report delivery date.
- Measuring/Monitoring/Testing: The auditor will perform a variety of tests, for example, to measure equipment performance or verify that a sensor is working correctly. Such tests should be selected to provide vital data about the equipment or information to show if certain types of improvements are feasible. If pre-existing data is not available or not sufficient, the auditor may also need to measure and monitor the energy profile and load to identify energy losses.
- Functional assessments: The auditor will assess the function of the systems by checking and analyzing all the data collected. The auditor will look for energy conservation opportunities which may involve conducting a study of their feasibility.
- Performing cost-benefit calculations: The auditor will create a cost model that presents the current and future value of energy conservation opportunities. This information will be presented so it is possible to see opportunity cost and year-over-year energy savings for the next 20 years.
- Proposing an action plan: The output of the audit is the proposed action plan, which will provide ways to manage and control power consumption and cost. Propose Energy Efficiency Measures (EEMs) that meet the Department's acceptable upgrade strategies and risk profile.

- Data Analysis: Perform engineering calculations. Prepare simulations using computerized analysis tools as required. Contact contractors to validate the likely cost of solutions and then incorporate into cost-benefit calculations.

Deliverables:

- Meeting Minutes
- Energy Efficiency Measures (EEMs)
- Building System Assessment
- Operational Efficiency Recommendations
- Energy Audit Report
- Energy Audit documents will be stored at: *40 Commissioning/01 Energy Audit*

Project Development Study

The CxA will participate in the Project Development Study (PDS), working with the DGS Design Project Manager, Portfolio Manager, and Cost Estimator to define the Owner's Project Requirements (OPR) of the project's systems, assemblies, and components in the PDS Report. These requirements will be further refined and elaborated on by the Professional and CxA during early Design Phase.

Key Activities:

- Review PDS Questionnaire
- OPR Workshop
- Site Visit (If applicable)
- Existing Documentation Review (If applicable)

Deliverables:

- Meeting minutes
- Report on findings for each system requirement
- Energy Audit documents will be stored at: *40 Commissioning/01 Energy Audit*

Design Phase

This section presents the typical scope requirements of the CxA during the design phase of the project. For every scope requirement, there are deliverables described.

Owner's Project Requirements (OPR)

For DGS projects, the Owner's Project Requirements (OPR) are documented in the Project's Design Criteria (PDC) document.

The PDC document is a description of the project and its systems, components, and assemblies. The PDC combines project requirements and the Professional's basis of design in one concise document.

At the onset of the project's design phase, the Professional will create the initial Project Design Criteria document which includes all information provided in the Project Development Study. The PDC is refined in schematic design and design development stage and used to ensure that all design criteria are incorporated in the construction documents.

The Commissioning Agent is expected to collaborate with the Professional by gathering project systems requirements and providing comment on and input to the building systems, operations and maintenance, and facility staff training requirements sections of the PDC. The CxA will work with the Professional to continuously update the PDC as systems and their performance requirements become more detailed and design progresses.

CxA provides valuable insights into the development of a comprehensive PDC document by leveraging their expertise in building systems and operations. It is the shared responsibility of the CxA and the Professional to coordinate, review and develop the PDC based on the Department and Client Agency's input.

Key Activities:

- DPM to verify that the PDC coordination has occurred with the DP.
- Understanding Project Goals: Review and understand the goals and objectives of the project as it relates to commissioning.
- Assessment of Systems: Evaluate existing or proposed building systems and infrastructure to determine capacity, efficiency, and suitability for the project. Participate in or lead alternatives analysis and documentation with the Professional.
- Identifying Cx Program Needs: Based on the project goals and systems assessment, identify the specific commissioning activities that must be accomplished to realize the project values.
- Realizing Project Value through Commissioning: Commissioning can improve project value achievement by facilitating implementation of systems which can positively impact the client agency experience. The CxA will contribute to the PDC by identifying means to accomplish this. The goal will be to align alternatives analysis for systems with project scope, project budget, and best practices.
- Technical Expertise: Provides technical expertise in areas such as HVAC (Heating, Ventilation, and Air Conditioning), lighting, controls, energy management systems, and building envelope, ensuring that the project incorporates best practices and industry standards.
- Risk Assessment: Assesses potential risks associated with systems to be commissioned and suggests risk management strategies to address them.
- Quality Assurance (QA): Evaluate that the PDC is written in such a way that will facilitate QA activities in construction, such as contractor coordination, installation inspection, and system start-up.
- Facilitate at least one OPR Workshop with the client agency, the facility maintenance staff, and the Design Professional to establish requirements for building systems, operations and maintenance, and facility staff training requirements. Publish meeting minutes within 7 days of the meeting.
- Collaborate with Professional's MEP consultants to define the performance requirements, design criteria and equipment selection based on feedback from the client agency.

- Make recommendations to the Professional and Department on equipment selection and specifications based on client agency requirements, budget, and schedule.
- Complete the DGS PDC Checklist (formally the OPR checklist) to facilitate development of the PDC document.

Deliverables:

- CxA to provide written review comments on Schematic Design PDC.
- CxA to provide written backcheck with comments on Design Development PDC.
- CxA to provide completed PDC Checklist with review and backcheck.
- OPR documents will be stored at: *40 Commissioning (Direct Folder)*

Conduct Design Reviews

The CxA will review the Professional's deliverables at each milestone submission in the design phase. The number of submissions will be defined in the RFQ, additional reviews may be requested at the discretion of the Department and authorized by additional work order.

The design review focuses on the drawings and specifications compliance with the requirements documented in the PDC. The particular focus areas that must be reviewed by the CxA include:

- Description of the commissioning process included in the specifications.
- Provisions for planned building operations
- Energy and water usage efficiency requirements
- System Control Sequences
- Maintainability
- Training and O&M documentation

Key Activities

- The CxA will attend a Page Turn Meeting in preparation for each design review.
- The CxA will provide its design review comments in Trimble in the appropriate design submission process by the due date established by the Design Project Manager, typically 14 calendar days after Professional submission.
- The CxA will attend a Design Review Conference to discuss their comments and the Professional's responses/revisions.
- The CxA will backcheck that all their comments were addressed and incorporated when the Department requires a revised partial submission or re-submission by the Design Professional.

Deliverables

- Design Review Comments, uploaded to Trimble.

- Backchecks uploaded to Trimble.
- Meeting minutes provided for all meetings attended.
- Annotated Submittal Register to indicate construction submittals that are to be reviewed by CxA.

Draft Design and Final Design Commissioning Plan

The Draft Commissioning Plan (Draft Cx Plan) outlines the scope of the commissioning activities along with the responsibilities, schedules, communication requirements, processes and procedures that must be performed to ensure systems are designed, installed, tested, and function according to the project requirements.

The Cx Plan is updated throughout the project and will include a list of required documents with assignments of responsibility, updated commissioning schedules, installation, verification and commissioning checklists and report formats. The Cx should communicate any changes to the Cx Plan to the Department.

Key Activities

- Conduct Commissioning Planning Meeting
- Gather review comments, respond, incorporate, and document.
- CxA and DPM coordination with the Bureau of Construction.
- DPM is responsible for evaluating the work products of the CxA and can utilize the CxA Plan Acceptance Criteria Checklist.

Deliverables

- Draft Design Commissioning Plan posted to Trimble by DD submission.
- Final Design Commissioning Plan posted to Trimble by CD acceptance.
- Final Design Commissioning Plan updates are posted to Trimble as the plan changes throughout the project.
- The Commissioning plan is submitted to the Department for review and approval through the DR-CxA process in Trimble.
- CxA to provide self-assessed Commissioning Plan Checklist with each submission.
- Commissioning Plan documents will be stored at: *40 Commissioning/02 Commissioning Plan*

The Department will review the Cx Plan for acceptance based on the requirements in the Cx Plan Acceptance Criteria. The specific requirements will vary based on the scope of the project.

Commissioning Specifications

The commissioning specifications provide detailed instructions on how installed systems and equipment are tested, inspected, and validated by the contractor to ensure they meet the Project Design Criteria and the systems' performance requirements.

The commissioning specification sections are developed by the CxA in coordination with the Professional through an iterative process. The CxA will review the technical design specifications and adapt the commissioning specifications to the project requirements. The Professional will similarly review the Cx specifications and adapt the technical and legal specifications to the Cx requirements.

The commissioning specifications include a general commissioning specification and one or more discipline specific specifications that include detailed requirements for that system.

To facilitate specification development, DGS has included several template commissioning specifications as appendices to this guide. These specifications have been edited to include DGS specific project language. The CxA must edit these template specifications for the specific requirements of the project. If a particular discipline specification is not available, it must be created by the CxA and should follow the general style of the template specifications.

The deliverables for the commissioning specifications include draft and final specifications text, related design review comments, and a backcheck to verify the Professional has correctly incorporated the sections into the project manual.

Key Activities

- CxA will collaborate with the Professional to coordinate the commissioning specifications with each technical specification.
- CxA must edit and modify the Department's commissioning specification templates to meet the requirements of the project.
- CxA specifications are provided to Professional in accordance with the design submission milestones and incorporated into project manual DD and CD drafts by the Professional
- Commissioning specifications are submitted for review in the DR-CxA process in Trimble.

Deliverables

- Draft Cx Specifications coordinated with Professional before DD submission.
- Final Cx Specifications coordinated with Professional before ICD/CD submission.
- Review comment backchecks to show that Professional has coordinated Cx and technical specification sections.
- Commissioning Specifications will be stored at: *40 Commissioning/04 Commissioning Specifications*

The Department will review the commissioning specifications for acceptance based on the requirements in the CxA Specification Acceptance Checklist.

Procurement Phase

Construction Commissioning Handoff Meeting

A handoff meeting will be conducted between the DPM, PC, and CxPgm to allow all Commissioning program information to be communicated between the Design team and the Construction team. Topics of discussion should include the status of Commissioning deliverables to date, items that are not complete, schedule for any tasks required from the DPM during Construction, and status of invoices. The Commissioning agent will not be in attendance for this meeting. A template agenda will be provided for the meeting.

Key Activities

- Handoff Commissioning responsibilities from DPM to PC.
- Determine whether the current CxA will be awarded a Construction Phase Work Order, or whether the work will be re-advertised.

Deliverables

- None from CxA. DPM will schedule and conduct meetings. CxPgm will provide meeting minutes, PC will Review, and DPM will approve.
- Meeting minutes will be stored at: *40 Commissioning/09 Commissioning Meetings*

Construction Phase

Construction Commissioning Kick-off Meeting

The Project Coordinator (PC) will schedule a kick-off meeting within two weeks following the Initial Job Conference (IJC). This meeting will be attended by the Commissioning team which typically includes the PC, Professional, CxA, Lead Prime Contractor, and any Prime Contractors with commissioning responsibilities. The PC may choose to invite other key project personnel, such as the DP, if necessary. This meeting informs all stakeholders of project expectations, roles, and commissioning responsibilities. It also integrates the commissioning milestones into the construction schedule, establishes communication protocols, and defines documentation required to achieve project milestones. The department will provide a template agenda for this meeting. The template agenda suggests topics to be covered.

Key Activities

- PC to edit template agenda for project specifics and schedule meeting with commissioning team members.
- CxA will collaborate with the project team to gather the information required to update the commissioning plan.
- CxA will discuss and refine Cx Meeting Schedule

Deliverables

- CxA to provide meeting minutes within 7 days.
- Meeting minutes will be stored at: *40 Commissioning/09 Commissioning Meetings*

Construction Commissioning Plan

The CxA will prepare the Final Design commissioning plan by the end of design. This Final Design commissioning plan will completely incorporate the CD version of the project. The CxA will finalize the Construction commissioning plan to reflect any changes that have been made during bidding. This will happen after contract awards, but prior to the Construction Commissioning Kick-off Meeting.

It is very important to the success of the project, that the final commissioning plan details, in plain language, all scopes that the prime contractors, sub-contractors, and testing agencies must perform to complete the project in its entirety.

The final commissioning plan will be reviewed by the DPM, PC, Professional, and CxPgm. The CA may elect to review as well. The PC will verify that all comments have been addressed and approve the plan.

Key Activities

- CxA to update commissioning plan to reflect project changes during bidding.
- CxA to verify coordination with final sequences of operations.
- CxA to collect and incorporate review comments and document complete backcheck.

Deliverables

- Construction Commissioning Plan will be uploaded to: *40 Commissioning/02 Commissioning Plan*

Commissioning Meetings

The CxA shall hold regularly scheduled jobsite commissioning meetings with all Prime Contractors, General Contractor, and the PC in attendance. Installation subcontractors may be invited by their primes as required. These meetings keep the commissioning process on track as the project progresses. The team should review progress, identify and resolve issues, coordinate testing and inspection, and discuss action items. These meetings are essential for keeping team members informed and efforts aligned with the Cx Plan.

The CxA staff at commissioning meetings will include expert staff in the discipline areas being discussed. The goal of the Cx Meeting will be to primarily discuss technical issues. Schedule and coordination issues will be identified and discussed and will be followed up in the regular construction meeting.

Key Activities

- Review Cx Issues/Resolution Log
- Review look-ahead schedule (2-4 weeks depending upon project)
- Review RFIs, potential change orders, retesting, and out of scope work

Deliverables

- The Commissioning Agent shall provide a Meeting Agenda outlining topics to be discussed prior to the start of meetings.
- The CxA shall provide Meeting Minutes within 7 days following meetings.
- The CxA shall provide updated Issues and Resolutions Log.
- Meeting Minutes will be uploaded to: *40 Commissioning/09 Commissioning Meetings*

Job Conferences

The CxA will attend all regularly scheduled job conference meetings throughout the duration of construction. Attendance may be virtual unless required to be in-person by the Department Representative. The CxA will be prepared to discuss schedule, issues, and action items that may have been developed at Commissioning Meetings.

Commissioning agents play a vital role in job conference meetings, ensuring that building systems are installed and operated as the design intended.

Key Activities

- Review look-ahead schedule (2-4 weeks depending upon project)
- Review RFIs, potential change orders, retesting, and out of scope work

Deliverables

- The CxA shall provide a summary report containing their meeting notes to document attendance at the meeting.
- The CxA shall provide commissioning activity schedule updates to the Lead Prime Contractor for incorporation into the master project schedule.
- Meeting Minutes will be uploaded to: *40 Commissioning/09 Commissioning Meetings*

Commissioning Matrix

The Commissioning Matrix is a living document, typically a spreadsheet, that identifies all items in the project to be commissioned. Each item is referred to by a unique and meaningful name such as an alphanumeric tag name or number. The matrix will document the status of all meaningful information about the item, including:

- Tag Name/Number
- Equipment Name/description
- System/Service
- Specification location
- Drawing number
- Submittal status
- Submittal approval date
- Final O/M submittal status

- Final O/M submittal approval date
- Startup date
- Prefunctional checklist status
- Prefunctional checklist complete date
- Functional checklist status
- Functional checklist completion date
- O/M training date
- Warranty start date
- Deferred seasonal testing date.
- 10-month warranty inspection date
- Notes

Key Activities

- The Cx Matrix will be developed in conjunction with the CD Design Documents and presented in draft form at the same time as the Draft Design Cx Plan.
- The Cx Matrix will be updated and included at the same time as the Final Design Cx Plan.

Deliverables

- The Cx Matrix will be updated as required and no less than monthly throughout the duration of construction.
- Meeting Minutes will be uploaded to: *40 Commissioning/02 Commissioning Plan*

Submittal Reviews

Contractor Submission – Contractor's upload submittal data into Trimble for the Professional to review.

Identification of Commissioning – Related Submittals – The CxA identifies via the submittal register which submittals need to be reviewed by the CxA.

Commissioning Agent Review – The Professional in Trimble will "Forward for Review" function to send the specific commissioning related submittals to the CxA. The CxA reviews the forwarded submittals, provides comments as necessary, and returns them to the Professional via Trimble.

Final Professional Review and Action – The Professional considers the CxA's comments during their review and makes the final determination. The Professional then stamps/signs and processes the submittal accordingly in Trimble.

Key Activities

- The CxA needs to review all submittals identified in the annotated Submittal Register.
- The CxA needs to backcheck all comments to verify that they were addressed by the Professional.

Deliverables

- Review comments
- Executed backcheck

Site Visit Report

A “Commissioning Site Visit Report” form will be submitted in Trimble by the Commissioning Agent using the “Commissioning Agent Activities” form. The topic selected would be – Cx Site Visit Report. The Commissioning Agent shall utilize and attach a report listing deficiencies, responsible party, corrective action, and correction date to the Cx Site Visit Report. The Attached document report will be automatically stored in folder, Documents \ 55 Construction \ 06 Test Results \ 03 Commissioning.

The Commissioning Agent shall send the Site Visit Report to the Professional using the “Commissioning Agent Activities” form. The Cx is to also cc/” Send To” all Prime Contractors. PC and APC to allow e-mail notification that the report was submitted and is in Trimble.

Preliminary O&M Review

The CxA will conduct the Preliminary O&M early in the construction phase. During this review, the commissioning agent will work closely with the project team to gather input and ensure that the documentation meets the needs of those who will operate and maintain the building systems.

Key Activities

- The CxA to review preliminary O&M documentation for system descriptions, equipment data, manufacturer provided operation procedures, and maintenance requirements and schedules.
- CxA to verify documentation is clear, user-friendly, and tailored to facility staff capabilities.
- The CxA will confirm that documentation aligns with project specifications and commissioning reequipments.

Deliverables

- The CxA to provide Preliminary O&M Review Comments Report.
- The CxA provides an O&M Review Checklist identifying the completeness and quality of each component of the O&M’s.
- Meeting minutes if applicable
- CxA to provide Tracking Log for O&M Documentation detailing “received, reviewed, returned for revision”.

- Preliminary O&M Documents will be uploaded to: *40 Commissioning (Direct Folder)*

Commissioning Issues and Resolutions Log

The Commissioning Issues and Resolution Log is a tool used to track, manage, and resolve any deficiencies or discrepancies identified during the commissioning process. Each issue entry should include key details such as issue description, affected system or equipment, location, priority level, responsible party, proposed resolution, and target resolution date. The log should be regularly reviewed in commissioning meetings to monitor status updates, with categories such as "open", "in progress", and "resolved". The issues log remains active throughout the testing phase and all items should be "resolved" before final acceptance/handover.

Key Activities

- The CxA to identify, document, and track all commissioning related issues encountered during design review, construction, start-up, functional testing, and final acceptance.
- The CxA to assign issues to responsible parties for action and resolution.
- The CxA to review at bi/weekly or monthly commissioning meeting with project team.

Deliverables

- Commissioning Issues and Resolutions Log will be uploaded to: *40 Commissioning/07 Issues Log*

Pre-functional Checklists

PFC's (Pre-functional Checklists) are critical tools in the commissioning process that are used to verify that equipment, systems, and components are properly installed and ready for testing and operation. These checklists are typically created by the CxA and are filled out during construction phase by the Prime contractor or their responsible subcontractors.

All Pre-Functional Testing and Reports will be completed and uploaded to the appropriate folder in Trimble for each Prime Contractor to review and act.

Key Activities

- The CxA will prepare blank PFC's for review by the Professional.
- The Professional will review and approve the PFC's.

Deliverables

- The CxA will send blank PFC's to the Prime Contractors for their use.
- Pre-functional Checklists will be uploaded to: *40 Commissioning/05 Systems and Readiness Checklists*

Pre-functional Testing

The contractor will conduct PFT's on all installed systems components prior to the inspection by the CxA.

Pre-functional Testing (PFT's) is the process of testing and operating individual equipment and components to ensure they are properly installed and ready for functional testing. This focuses on checking mechanical, electrical, and control elements to confirm they meet design intent and operate in accordance with manufacturers published installation and operation instructions.

Key Activities

- The Prime Contractor will conduct complete PFT's of all installed components.
- The Prime Contractor will document all PFT's by completing the PFC's.
- The CxA will review and approve all PFC's prior to scheduling Pre-Functional Inspections.

Deliverables

- The Prime Contractor will upload all complete PFC's to: *40 Commissioning/05 Systems and Readiness Checklists*

Equipment Start-up

The CxA will inspect and sign off on all installed system components prior to functional testing.

Equipment Start-up is the process of verifying that PFT's were completed. PFI's will also include an inspection of the installation for compliance with applicable codes and standards of practice.

Any deficiencies encountered will be annotated by the CxA on the Issues and Resolutions Log. The Prime Contractor may remediate, repair, and retest components the same day, if possible. The CxA will annotate whether deficiencies were addressed or deferred. Deferred testing may require an additional services Work Order (WO) from the CxA, which may be paid for out of Prime Contractor retainage.

Key Activities

- After receipt and approval of all PFC's, CxA will schedule inspection of all components and systems to be commissioned.
- Prime Contractor will demonstrate and test all systems and components for the CxA.
- CxA will sign off on all PFC's by indicating completion of Equipment Start-ups.

Deliverables

- The CxA will upload the execute PFC's to: *40 Commissioning/05 Systems and Readiness Checklists*

Functional Performance Procedures

Functional Performance Procedures (FPPs) are step-by-step procedures that a CxA uses to test and verify that systems and equipment perform as intended under real-world conditions. These procedures assess how components and integrated systems work together to meet the operational requirements and design specifications. The CxA develops, coordinates, and executes these tests, with the assistance of the Prime Contractors.

Key Activities

- The CxA develops FPP's.
- The CxA provides FPP's to the Professional for approval.
- The CxA distributes approved blank FPP's to the Prime Contractors for their preparation for FPT's.

Deliverables

- The blank FPP's to be uploaded to: *40 Commissioning/03 Functional test Procedures and Docs*

Functional Performance Testing

Functional Performance Testing (FPT's) are the execution of the FPP's by the CxA with the assistance of the Prime Contractor. FPT's may require multiple sessions to verify different testing use cases and dependencies, such as testing HVAC system operation during winter and summer months.

Any deficiencies encountered will be annotated on the Issues and Resolutions Log by the CxA. The Prime Contractor may remediate, repair, and retest the systems the same day, if possible. The CxA will annotate whether deficiencies were addressed or deferred. Deferred testing may require an additional services Work Order (WO) from the CxA, which may be paid for out of Prime Contractor retainage.

The CxA is responsible for verifying that all building automation and control systems are installed, programmed, and functioning in accordance with the design intent, project specifications, and owner's

project requirements. This includes reviewing control sequences of operation to ensure they are properly implemented and integrated across all systems.

Functional Performance Testing (FPT's) shall be conducted to verify that control systems respond appropriately to both normal and failure scenarios, as outlined in the design documents. The CxA will also ensure proper integration of controls with other building systems, such as HVAC, lighting, and security, and verify that trending and monitoring capabilities are functioning as required.

Any issues identified during testing shall be documented on the Issues and Resolutions Log, communicated to the contractor for resolution, and tracked for completion. The results of the control system verification shall be summarized in the commissioning report, along with any recommendations for optimizing system performance.

Key Activities

- Scheduled by the CxA.
- Executed by the CxA with the assistance of the Prime Contractor.

Deliverables

- The executed FPP's will be uploaded to: *40 Commissioning/03 Functional Test Procedures and Docs*

Retesting of Failed Systems

This scope item is reserved for some limited retesting of systems when deficiencies are found. If significant retesting is required, it is suggested to have the CxA to use this time to prepare an additional services work order. For a typical project it may be reasonable to include 8 hours of retesting for each system that is to be commissioned. This should be identified in the RFQ so that each CxA can include it in their proposal with a limited impact on the cost competitiveness of their proposal.

Key Activities

- Determine if retesting is required and if so, can it be done within the allotted hours.
- If the retesting cannot be completed within the allotted hours, prepare and submit an additional services work order.

Deliverables

- Documentation of key activities is uploaded to: *40 Commissioning/06 Test and Inspection Reports*

TAB Review & Verification

The CxA shall review the Testing, Adjusting, and Balancing (TAB) report via the submittal process, to ensure it is complete and includes all required data, including airflow measurements, equipment performance, and balancing results. The CxA will verify the accuracy of the report by cross-referencing it with design documents.

Spot checks, which frequency should be determined by the project team, shall be conducted in the field to identify any discrepancies between documents. Any issues found in the TAB report must be

communicated to the TAB contractor for resolution. Comments should also be uploaded in the submittal process in Trimble.

A summary of the review, verification process, and any corrective actions should be included in the commissioning report. If unresolved issues arise, the CxA will collaborate with the design team to determine an acceptable resolution.

Key Activities

- CxA to attend TAB coordination meeting with TAB Contractor, Prime Contractor, and Professional.
- CxA to review and comment on the TAB Plan and Report and coordinate with the Professional for approval.

Deliverables

- TAB coordination meeting minutes uploaded to: *40 Commissioning/09 Commissioning Meetings*
- Upload TAB Report review comments and backcheck to: *40 Commissioning/06 Test and Inspection Reports*

Training

The CxA shall oversee and verify that the owner training process prepares the building operations and maintenance staff to operate and maintain all commissioned systems. This includes reviewing the training agenda, materials, and schedule to confirm alignment with the project requirements and system complexity.

The CxA shall ensure that the training covers system operations, sequences of operation, maintenance procedures, troubleshooting protocols, and the use of relevant documentation, such as the operations and maintenance (O&M) manuals. During the training sessions, the CxA will observe and evaluate the quality of instruction provided by the contractors or vendors, ensuring it is clear, accurate, and accessible to the staff. Ensure that an appropriate level of operator, maintainer, or supervisory training is provided to meet the owner's requirements.

Any deficiencies in the training shall be documented and addressed to ensure the owner's personnel are fully prepared. A summary of the training process, along with any recommendations for supplemental training, shall be included in the final commissioning report.

Key Activities

- CxA to review the training plan and all training materials, prior to training taking place.
- CxA to provide review comments to the Professional and coordinate for approval.
- CxA to attend all training sessions.

Deliverables

- Review comments and backcheck of Training plan and training materials.
- CxA documentation of training attendance and approval.

Scheduling

The CxA will collaborate with the project team to ensure that commissioning activities are integrated into the master schedule. CxA shall coordinate with contractors, subcontractors, and other stakeholders

to ensure that prerequisites for commissioning activities, such as system readiness and access to equipment, are met.

The CxA will also track commissioning progress and adjust scheduling as needed to address delays or changes in the construction sequence. Any scheduling conflicts or risks that could impact commissioning shall be communicated promptly to the project team to ensure timely resolution. The commissioning agent will monitor the master schedule, ensuring that all required activities are completed prior to final acceptance and project turnover. The CxA is responsible for adjusting their schedule based on the changes of the project schedule, failure to do so absolves the Department of General Services of additional services work orders.

Key Activities

- CxA to review master schedule and provide commissioning schedule input at each construction meeting.

Deliverables

- CxA to upload the current monthly commissioning schedule prior to every construction meeting to: *55 Construction/02 Schedules/01 Schedules*

Punchlist Participation

The CxA and the Professional will work together to ensure that deficiencies or open items that have been identified through the Cx process are incorporated into the project punch list. The CxA will continue to work with contractors to resolve outstanding items, however this process will allow for better integration of commissioning findings into the overall project closeout, ensuring that all performance-related issues are addresses prior to final acceptance.

Key Activities

- The CxA will keep the Issues and Resolutions Log up to date.
- The Professional will incorporate the Issues and Resolutions Log into the Punchlist at the time of creation.
- The CxA will review the Punchlist to verify that issues are accurately recorded and coordinate with the Professional if they are not.
- The CxA will edit the issues and resolutions log to reflect updates and notify professional as items are added or resolved. The CxA will incorporate resolutions as they are discovered.
- The CxA will coordinate with the Professional for Final disposition of issues.

Deliverables

- Commissioning Issues and Resolutions Log will be uploaded to: *40 Commissioning/07 Issues Log*

Closeout Phase

Commissioning Report

The commissioning report serves as the final record verifying that all commissioned systems have been installed, tested, and verified to meet the design intent, project specifications, and owner's project

requirements. The report shall include an executive summary, a description of the commissioning scope and process, and a list of all systems and components commissioned. It should document the results of equipment inspections, testing, adjusting, and balancing (TAB) reviews, functional performance tests, and issue resolution logs.

The report must also include any outstanding issues, deferred tests, or recommendations for future system optimization. Supporting documentation, such as checklists, test forms, and trend logs, should be added as necessary. The commissioning report provides the Department with a comprehensive record of system performance and serves as a valuable resource for ongoing operations, maintenance, and troubleshooting.

Key Activities

- The Commissioning Agent will submit via Trimble Process the Final Commissioning Report. Once reviewed by the PC, he or she will request comment from the Professional.
- Once Professional reviews/approves, the PC should request comment from the DPM for final acceptance.

Deliverables

- Commissioning Report will be uploaded to: *40 Commissioning/08 Commissioning Report*

Commissioning Manual or Systems Manual

The Commissioning Manual, also known as the Systems Manual, is a document prepared by CxA that combines critical information about the commissioned systems into a single, comprehensive reference for the client agency or DGS maintenance. This manual includes an overview of the commissioning process, a list of commissioned systems, and key project documents, such as the final commissioning report, as-built drawings, and approved submittals. It also contains system descriptions, sequences of operation, maintenance procedures, troubleshooting guidelines, and setpoints or operational parameters for all major equipment.

The manual should include training materials, equipment warranties, and contact information for vendors and service providers. The CxA is responsible for organizing this information, ensuring its accuracy and completeness, and presenting it in a user-friendly format. The Commissioning Manual serves as an essential resource for maintaining optimal system performance throughout the building's lifecycle.

Key Activities

- The CxA will combine the systems manual into a single document for the Department.
- The PC and DPM will accept the Systems Manual and verify its accuracy with the project.

Deliverables

- Commissioning Manual will be uploaded to: *40 Commissioning (Direct Folder)*

Deferred Testing

Deferred testing occurs when certain commissioning tests cannot be completed during the normal commissioning process due to factors such as weather conditions, incomplete system integration, or the

unavailability of utilities or equipment. Common examples include testing heating systems in the summer, cooling systems in the winter, or systems that require specific loads or occupancy conditions.

The CxA is responsible for identifying deferred tests, documenting the reasons for deferral, and developing a plan for completing them at an appropriate time. This plan should specify the conditions required for testing, the responsible parties, and the anticipated timeline. The deferred testing plan must be included in the commissioning report, and the CxA should track and verify the completion of all deferred tests to ensure the systems meet the design intent and owner's project requirements. Any remaining deferred tests should be clearly communicated to the owner during project turnover.

Key Activities

- The CxA needs to identify tests that must be deferred due to timing, environmental conditions or systems.
- Develop a deferred testing plan that includes responsible parties, schedule, and specific test conditions required.

Deliverables

- Deferred Testing Report will be uploaded to: *40 Commissioning/06 Test and Inspection Reports*

Warranty Inspection

The CxA conducts a warranty inspection near the end of the warranty period to verify that all commissioned systems are operating as intended and to identify any issues that require correction under the warranty terms.

During this inspection, the CxA will review system performance data, conduct site visits, and interview building operations staff and client agency to gather feedback on system functionality, maintenance challenges, or recurring issues. The inspection may also include limited re-testing of systems or equipment to verify that performance has not degraded since the original commissioning process. Any identified issues, such as equipment malfunctions or control inconsistencies, will be documented and communicated to the appropriate parties for resolution before the warranty period expires. The CxA shall provide the Department with a warranty inspection report summarizing findings, recommended corrective actions, and any suggestions for optimizing system performance and maintaining operational efficiency.

Key Activities

- The CxA needs to schedule and conduct a warranty-phase inspection near the end of the warranty period.
- CxA to document all identified issues.
- Develop and submit a summary report to the Department.
- PC to send to Professional for review of Warranty Inspection Report.

Deliverables

- Warranty Inspection Report will be uploaded to: *40 Commissioning/06 Test and Inspection Reports*

SECTION 4 – CONTRACT ADMINISTRATION

Department Representative

DGS will designate a Department Representative with primary responsibility for Contract Administration on each project. This person will serve as the primary point of contact for all communications related to project commissioning. The Department Representative will coordinate with the CxPgm and other DGS staff to resolve any issues which may arise in the execution of the work.

During the Pre-design and Design Phases of the project, the DPM will act as the Department Representative. During the Procurement and Construction Phases of the project, the PC will act as the Department Representative.

Work Order

Upon notification of award, the successful contractor shall initiate a separate work order in Trimble for each phase of the project they are engaged in, which may include Pre-Design, Design, and Construction, reflecting the exact amount of the cost proposal for that phase.

The Commissioning Agent (CxA) must attach their technical proposal with Attachment A – Scope of Work along with the RFQ Scope of Work when submitting their Work Order. The Work Order should correspond to the specific phase outlines in the RFQ – Pre-Design, Design, or Construction.

All line items in the cost proposal shall be entered by the Commissioning Agent into a schedule of values in Trimble that matches the cost proposal (Attachment B) submission to facilitate measurement and payment of the contractor's work.

Schedule of Values

The cost proposal will be entered into a Schedule of Values (SOV) by the Department Representative. Each cost proposal line item will be treated as a not-to-exceed scope and cost quantity.

Invoices and Progress Reports

The CxA shall submit applications for payment to DGS. The CxA must submit invoices via Trimble INVAP process, with the proper backup information, which will include:

- Time sheets
- A correctly completed Attachment D – Progress Billing Report
- Current Certificate of Insurance form
- Monthly report attached as backup

The contractor must ensure their time sheet and invoice work descriptions match exactly their cost submission line items in Attachment D – Progress Billing Report. The CxA will post all deliverable documentation to Trimble. The Department Representative will verify task completion based upon this deliverable documentation posted in Trimble.

Invoice applications will be reviewed monthly or as received, and either rejected or approved based on information submitted with the invoice and deliverables documented in Trimble. Invoices will be rejected if progress reports are not completed, the timesheet backup does not match Cost Proposal and Schedule of Values, deliverables are missing, or insurance certificates are not up to date. Once invoices are approved, DGS will make progress payments to the CxA, in accordance with the provisions of the prompt payment schedules found in the Commonwealth Procurement Code.

Insurance

The CxA shall, at its expense, purchase and maintain the following types of insurance issued by companies authorized to do business in the Commonwealth by the Pennsylvania Insurance Department or by the Department of Labor and Industry, as applicable:

- Professional Liability Insurance to provide protection against loss resulting from negligent acts, errors and omissions arising from providing these CxA services and activities. Unless otherwise specifically provided in the Agreement, the CxA shall be required to secure and maintain professional liability insurance with a minimum coverage of $1,000,000.
- Worker's Compensation insurance sufficient to cover all employees of the CxA working to fulfill the Agreement.
- Comprehensive General Liability insurance and motor vehicle liability insurance in such amounts as the Commonwealth deems sufficient which shall not exceed $1,000,000 for bodily injury or death and $500,000 for property damage. The policy shall be occurrence-based and shall name the Commonwealth of Pennsylvania, Department of General Services, as an additional insured.

Prior to commencement of work under the Agreement, the CxA shall provide the Commonwealth with current, valid certificates of insurance (COI) reflecting the requirements stated. These certificates shall contain a provision that DGS must be notified at least thirty (30) days prior to any change in, or cancellation of, coverage afforded under the policies.

The CxA shall provide a valid COI along with every invoice application.

Reference the Invitation to Qualify (ITQ) which documents all insurance requirements.

Deliverable Submission, Review and Approvals

The CxA will submit deliverable using the DR-CX process in Trimble.

Onboarding

After a commissioning agent is hired by the Department, onboarding will be scheduled. The Department Representative will conduct onboarding using an onboarding meeting template. The goal of the onboarding meeting is to describe the expectations of the department and give the commissioning agent an understanding of what the requirements for success are.

Document Management

The Commissioning Agent is responsible for ensuring that all deliverables are systematically posted to designated folders as shown below (hyperlink). These deliverables must be organized and uploaded to

the specified locations to ensure accessibility and transparency. This responsibility includes adhering to the project's documentation protocols, maintaining accurate records, and ensuring that all stakeholders can easily access the necessary information in the appropriate folders. If the commissioning agent is utilizing an independent software tool (CxAlloy, etc.), they are still responsible for maintaining and adhering to the requirements for storing and uploading deliverables to Trimble.

https://app.e-builder.net/da2/daLanding.aspx?QS=c2967c3e371e43adbfea1770677171b0

Evaluations

During the project the department may evaluate the contractor during the pre-design, design, and construction phases of the project. Invoice applications will be processed based on actual progress.

DGS will monitor quality of contractor work and use performance management tools as required to communicate and resolve deficiencies. Repeated or persistent deficiencies will result in enrollment in the contractor responsibility program (CRP).