Commissioning Guide

Transportation and Infrastructure
Building Design and Construction Division

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Purpose of the Guide

Transportation and Infrastructure, Building Design and Construction Division has developed and implemented a Commissioning Process which is intended to be used on all building projects. This Guide will detail the process and provide clarification to all users as to their roles and responsibilities. The process is to be used consistently on projects province wide, providing a measure that the Owner has received a final product that meets or exceeds their expectations.

3. Intent of Commissioning

To verify that the project's systems and components are installed, calibrated and perform according to the Owner's Project Requirements (OPRs), Basis of Design (BOD) and construction documents.

4. Definition of Commissioning

An intensive quality assurance process, that begins at the beginning of the project and continues through to the first year of occupancy. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.

5. Reference Codes and Standards

1. ASHRAE GUIDELINE 0-2005 - The Commissioning Process
2. LEED ® Canada for New Construction and Major Renovations 2009
3. Canada Standards Association Z320-11 Building Commissioning
4. Natural Resources Canada – 1st Edition Commissioning Guide for New Buildings

6. Commissioning Process Overview

The concept design phase is critical for the success of the whole commissioning process as it defines the "Owner's Project Requirements" that will guide the design, construction and operation of the facility.

In the design phase, the project evolves from the concept to plan, drawings and specifications. The commissioning activities ensure that as the building becomes reality, its systems and operations reflect the OPR.

During the construction phase, numerous aspects of the project are monitored and implemented to ensure the building systems and equipment are installed and tested according to the OPRs.

The initial occupancy and operations phase is essential to close successfully the Commissioning process and to ensure that the expected benefits will persist beyond the typical on-year warranty period.

7. Commissioning Team

The commissioning team shall be comprised of:

1. Commissioning Authority (CxA)
2. Design Manager (DM)
3. Construction Manager (CM)
4. Design Consultant (DC)
5. General Contractor (GC)
6. Project Coordinator (PC)
7. Technical Services Inspector (TSI)
8. Sub-Contractors
9. Building Manager (BM)
10. Owner

8. Abbreviations

BM – Building Manager
BOD – Basis of Design
CDR – Concept Design Report
CM – Construction Manager
CxA – Commissioning Authority
DC – Design Consultant
DDR – Design Development Report
DM – Design Manager
GC – General Contractor
IFC – Issued for Construction
IFT – Issued for Tender
LEED – Leadership Energy Environmental Design
PC – Project Coordinator
TSI – Technical Services Inspector
OPR – Owner Project Requirements
PMDA – Project Management Design and Administration Manual

9. Definitions

Basis of Design – documentation of the primary thought processes and assumptions behind design decision that were made to meet the Owner's Project Requirements. The Basis of Design describes the systems, components, conditions, and methods chosen to meet the OPR.

Commissioning – a systematic verification, documentation, and training process applies to all activities during the design, construction, static verification, start-up and functional performance testing of equipment and systems in a facility to ensure that the facility operates in conformity with the Owner's Project Requirements and the Basis of Design in accordance with the contract documents.

Commissioning Authority – and individual identified by an owner to lead the commissioning team in the implementation of the commissioning process.

Commissioning Checklists – the forms used to document the inspections, test, etc., performed during the commissioning process

Commissioning Manual – manual that documents the commissioning process and contains all relevant information required to re-commission the facility.

Consultant – individual who provides specialized resources and skills

Contract Documents – the documents that form the basis of a contract between and owner and primary contractor. These include specifications, drawings, tender forms, change orders, addenda and site instructions.

Contractor – and individual or company that enterers into a contract with an owner to undertake a project

Control System – a local system that controls the operation or a stand-alone mechanical system or mechanical equipment. A control system comprises controlled devices, controlling devises, control wiring, power supply and a control air system.

Construction Manager – the individual responsible for coordinating the construction of the project.

Deferred Testing – the postponement of functional performance testing of equipment or systems due to the absence of required conditions (e.g. seasonal heating/cooling).

Designer – any special consultant who is involved in the planning and design process.

Design Manager – the individual responsible for coordinating the design of the project.

Design Intent – the performance that a design is intended to achieve in order to meet the OPR and BOD. This master plan for the system is sometimes referred to as the "design concept".

Inspection – a service provided as part of the normal scope of a designer's work.

Installation verification – inspections and checks completed prior to performance testing, ensuring that the facility is ready for performance testing.

Issues Log – A formal and ongoing record of problems or concerns, and their resolution that have been raised by the CxA or any member of the commissioning team. There are usually three different issues logs created: design review, construction observation and Performance Verification.

Maintenance and Data Manual – detailed document that provides the operating and maintenance requirements and associated data for the safe and efficient operation of specific pieces of equipment and systems

Owner – the entity that represents the interests of the facility

Owner's Project Requirements (OPR) – a dynamic document that provides the explanation of the ideas, concepts, and criteria that are considered to be very important to the owner. The OPR should cite specific measurable goals for the owner's objective to the greatest extent possible.

Performance Testing – a full range of tests under actual load, conducted to verify that specific systems, components and interfaces between systems conform to a given criteria.

Seasonal Testing – testing of equipment and systems that have been functionally tested during winter or summer conditions and require retesting during the opposite conditions.

Systems Operation Manual – a document that describes the operation of all the systems and equipment in a facility. Detail modes of operation and includes associated diagrams that illustrate the sequence of operation for each system and interaction between individual systems.

10. STEP 1 – Assign Commissioning Authority

Designate an individual as the Commissioning Authority (CxA) to lead, review, and oversee the completion of the commissioning process activities. This is requested by the Design Manager to the Manager of the Building Design and Construction Division, who will then assign staff appropriately.

Ideally, the project team should designate an individual as the CxA as early as possible in the project timeline, preferably during pre-design. The qualified individual designated as the CxA serves as an objective advocate for the Owner and is responsible for the following:

1. Directing the Commissioning Team and process in the completion of the commissioning requirements.
2. Coordinating, overseeing, and/or performing the commissioning testing.
3. Reviewing the results of the systems performance verification.

The CxA may be a qualified staff member of the Owner, an Owner's consultant to the project, or an employee of a firm providing design and/or construction management services. The CxA may not, however, have responsibility for design (e.g. be the engineer of record) or for construction. The CxA must report results, findings, and recommendations directly to the Design Manager.

11. STEP 2 – Owner Project Requirements and Basis of Design

The Owner must document the project requirements, in a document referred to as "Owner Project Requirements" (OPR).

The Design Team must develop the Basis of Design, in a document referred to as "Basis of Design" (BOD).

The Owner and Design Team are responsible for updates to their respective documents.

Clear and concise documentation of the OPR and the BOD is a valuable part of successful project delivery and commissioning process. These documents are used throughout the commissioning process to provide a baseline and focus for validating systems' energy and environmental performance.

This document will become part of the final Commissioning Report.

11.1 OWNER'S PROJECT REQUIREMENTS

The OPR must be developed by the Owner, and submitted to the TI Design Manager prior to the start of design. The purpose of this document is to clearly document the functional requirements and expectations of the Owner for the project and serves as a touchstone for all subsequent commissioning activities. Updates during the design and construction process are the responsibility of the Owner.

The OPR document should address the following issues, as applicable to the project:

1. Owner and user requirements
2. Environmental and sustainability goals
3. Energy efficiency goals
4. Indoor environmental quality requirements
5. Equipment and system expectations
6. Building occupant and operations/maintenance personnel requirements

The level of detail in the OPR can vary depending on the size and function of the facility, the owner's preferences, and the design team experience. A template table of contents for the OPR can be found in Appendix A.

Throughout the design process this document may be revised, a log of review comments and revision must be kept by the Design Manager.

11.1.1 Owner and User Requirements

Describe the primary purpose, program, and use of the proposed project and any pertinent project history. Provide any overarching goals relative to program needs, future expansion, flexibility of function, quality of materials, and construction and operational costs.

11.1.2 Environmental and sustainability goals

Describe any specific environmental or sustainability goals (e.g. LEED certification).

11.1.3 Energy efficiency goals

Describe overall project energy efficiency goals relative to the local energy code, ASHRAE standard, MNECB, or LEED. Describe any goals or requirements for building orientation, landscaping, facade, fenestration, envelope and roof features that will affect energy use.

11.1.4 Indoor environmental quality requirements

For each program or area, describe the intended use, anticipated occupancy schedules, space environmental requirements (including lighting, temperature, humidity, acoustics, air quality, and ventilation), desired adjustability of system controls, and accommodations for after-hours use. This can be accomplished most efficiently using typical room data sheets. A sample room data sheet can be found Appendix B.

11.1.5 Equipment and system expectations

Describe the desired level of quality, reliability, type, automation, flexibility and maintenance requirements for each of the systems to be commissioned. When known, provide specific efficiency targets, desired technologies, or preferred manufacturers for building systems

11.1.6 Building occupant and O&M personnel requirements

Describe how the facility will be operated and by whom. Describe the desired level of training and orientation required for the building occupants to understand and use the building systems.

11.2 BASIS OF DESIGN

The Design Consultant must document the Basis of Design (BOD) for each discipline. During the process the Commissioning Authority, Design Manager, TI Technical review team, and Owner will have an opportunity to review and comment on the BOD. A log recording the comments and responses must be kept.

The BOD is the document that the designers prepare to identify the decisions, systems, and selections made to satisfy each of the Owner's Project Requirements and satisfy applicable regulatory requirements, standards, and guidelines. This document should be updated by the Design Consultant with each subsequent design submission, with increasing specificity as applicable.

The BOD should include the following, as applicable:

1. Major owner's requirement
2. Primary design assumptions
3. Design decisions

4. Codes
5. Standards
6. Regulatory requirements
7. Narrative descriptions

A table of contents for the BOD can be found in Appendix C. This format should be carried throughout the entire design process in order to facilitate the review process.

The BOD is the preliminary document showing an understanding of the design requirements of the Owner. Often this can be the same document as the Concept report. Clarification from the CxA should be sought for each project.

Subsequently, the Concept Design Report (CDR) gets further developed into the Design Development Report (DDR). The TI Project Management Design and Administration Manual (PMDA) should be referenced for the level of detail required. From the DDR the CxA will extract the System Descriptions and equipment lists required for the Cx Manual. The Consultant shall insure that this information is readily available.

11.2.1 Primary design assumptions

Include space use, redundancy, diversity, climatic design conditions, space zoning, occupancy, operations, and space environmental requirements.

11.2.2 Standards

Include applicable codes, guidelines, regulations, and other references that will be put into practice.

11.2.3 Narrative descriptions

Include performance criteria for the HVAC&R systems, lighting systems, hot water systems, on-site power systems, and other systems to be commissioned. All disciplines shall be addressed.

12. STEP 3 – OPR and BOD Review

The CxA must review the Owner's Project Requirements and the Basis of Design for clarity and completeness. The Owner and Design Team are responsible for updates to their respective documents.

The CxA must ensure that the Basis of Design reflects the Owner's Project Requirements. Both documents must be reviewed by the CxA for completeness prior to the approval of contractor submittals of any commissioned equipment or systems.

13. STEP 4 – Commissioning Manual

The CxA develops and issues a project specific Commissioning Manual. Input is required from the commissioning team. The Commissioning Manual is the reference document that identifies the strategies, aspects, and responsibilities within the commissioning process for each phase of a project for all project team members. This document outlines the overall process, schedule, organization, responsibilities, and documentation requirements of the commissioning process.

The Commissioning Manual is developed at the start of the commissioning process, preferably during design development, and is updated during the course of a project to reflect any changes in planning, schedule, or other aspects. As this document is reviewed and revised, a log of comments and responses must be kept. The following list outlines required components of the Commissioning Manual.

1. Commissioning Program Overview
    a. Goals and objectives
    b. General project information
    c. Systems to be commissioned
    d. Schedule

2. Commissioning Team
    a. Team members, roles, and responsibilities.
    b. Communication protocol, coordination, meetings, and management.

3. Commissioning Process Activities
    a. Documenting the Owner's Project Requirements
    b. Preparing the Basis of Design
    c. Reviewing the design phase documentation
    d. Reviewing the construction phase documentation
    e. Developing systems functional test procedures
    f. Verifying systems installation and functional performance
    g. Reporting deficiencies and the resolution process
    h. Accepting the building systems
    i. Documenting the commissioning review process
    j. Reviewing contractor submittals
    k. Developing the Systems Manual
    l. Verifying the training of operations personnel
    m. Reviewing building operation after final acceptance
    n. 10 month warranty review and occupant survey
    o. Listing the commissioning process milestones

Template table of contents for the Commissioning Manual can be found Appendix D.

14. STEP 5 – CxA Design Document Review

The CxA should review the OPR, BOD, and design documents (concept and design development reports, drawings and specifications) to give the Owner and Design Team an independent assessment of the state of the design for the commissioned systems. Typically, a design review performed by the CxA focuses on the following issues:

1. Ensuring clarity, completeness, and compliance with the OPR.
2. Verifying that all issues discussed in the OPR are addressed adequately in the BOD.
3. Reviewing design documents for achieving the OPR and BOD and coordination of commissioned systems.

Specific review items will vary from project to project, however, generally will include:

1. During the design process:
    a. The CxA does a general review to ensure that the basic level of quality is present in the design, checking for items such as legibility, labeling, and continuation of items from sheet to sheet.
    b. The CxA examines the implication of system choices to ensure that the design will meet the specifications in the OPR.
    c. The CxA reviews system schematics to verify that the general arrangement of systems and equipment is in alignment with the OPR and BOD.
    d. The CxA will review the design decisions for:
        i. Sizing and selection of building systems and equipment
        ii. Accessibility of equipment for operations and maintenance
        iii. Energy impact of design decisions
        iv. Details of the controls design relative to equipment being controlled
        v. Ability of controls interface to facilitate trending and identify equipment faults during Performance Verification
        vi. Identification and access of test ports, sensors and in-situ measurements devices for use in Performance Verification
        vii. Identification of any potential barriers to good Operations and Maintenance of the facility design and suggest alternative approaches
2. Construction Document Review will generally consist of:
    a. Details on energy efficiency, maintenance requirements and other detailed required to ensure compliance with the OPR
    b. Equipment and sensor selection and testing tolerances
    c. Manufacturer's recommended start-up tests
    d. Warranty data
    e. Controls submittals for inclusion of required control points
    f. Controls submittals for functional capabilities in trending points
    g. Operation and Maintenance Manual content

Review comments from the CxA will follow through the normal TI review process.

Additional reviews by the CxA throughout the design and construction process may be advisable and appropriate depending on the project duration, phasing, and complexity.

The Commissioning Manual shall be completed and issued as part of the tender package.

15. STEP 6 – Construction Documents

Develop and incorporate commissioning requirements into the construction documents. The designer is responsible for the specification, although the CxA will draft and review final revision of the specification.

The project specifications are used to inform contractors of their responsibilities in the commissioning process.

Commissioning requirements are outlined in the construction specifications. The specification defines the contractors' commissioning related responsibilities, including equipment installation, start-up, documentation, Installation Verification, and Performance Verification.

The Commissioning Manual will be part of the Construction Document package.

The following items should be included in the construction documents:

1. Commissioning team involvement
2. Contractors' responsibilities (e.g. schedule, supply of manpower, tools, equipment, etc)
3. Submittal review procedures for commissioned systems
4. Operations and maintenance documentation, system manuals
5. Meeting requirements, frequency, attendance
6. Inspection verification procedures
7. Startup plan development and implementation
8. Performance Verification
9. Acceptance and closeout
10. Training requirements
11. Warranty review site visit

16. STEP 7 – Contractor Submittal Review

The CxA should review contractor submittals applicable to the systems being commissioned for compliance with the OPRs and BOD. This review must be concurrent with the architect's or engineer's reviews and submitted to the Design Team and the Owner.

The CxA should review the contractor submittals and identify any issues that might otherwise result in rework or change orders. The CxA should specifically evaluate the submittals for the following:

1. Conformance with the OPRs and BOD
2. Fulfilling operation and maintenance requirements
3. Facilitating performance testing

The CxA review of contractor submittals does not typically replace or alter the scope or responsibility of the Design Team's role in approving submittals.

17. STEP 8 – Construction Phase Commissioning Activities

Commissioning is conducted to verify the performance of commissioned systems as installed to meet the OPR, BOD, and contract documents.

Verification of the installation and performance of commissioned systems typically includes 3 steps for each commissioned system:

1. Installation Verification
2. Performance testing
3. Comparison of the results with OPR and BOD

Sample checklists can be found Appendix E.

17.1 COMMISSIONING MEETINGS

During the design and construction process commissioning meetings are held on a regular basis. The schedule of meetings should be documented as early as possible during the construction phase. As the schedule changes a minimum of two weeks notice will be given for change in time and location, allowing all team members to adjust their schedules accordingly.

17.1.1 Kickoff Meeting

The kickoff meeting brings together all members of the design, construction, and operations team that will be involved in the Commissioning Process. Each building system to be commissioned is addressed, including commissioning requirements, and completion and start-up schedules.

Meetings will be chaired by the CxA or CM; meeting minutes will be prepared and issued by the CxA or CM. Clarifications to the minutes must be submitted within 5 days of issue, after which, the issued set becomes the official project record.

Required attendance:

1. Owner
2. Construction Manager
3. Design team
4. General Contractor
5. Representative from each sub-contractor

Typical Agenda items:

1. Scope of work
2. Tasks
3. Schedules
4. Deliverables
5. Documentation process
6. Communications process
7. Roles and responsibilities

Sample agenda and minutes can be found in Appendix I. The same agenda will be used for all Commissioning meetings, with additions or deletions as necessary.

17.1.2 Monthly Cx Meeting

Convene Cx meetings following project meetings to resolve issues, monitor progress and identify deficiencies relating to Cx.

The CxA may attend in person if schedules match, otherwise teleconference will be initiated.

During these meetings general status updates are provided by the contractor, clarifications of requirements are discusses and questions regarding general Commissioning Process will be answered.

Meetings will be chaired by the CxA or CM; meeting minutes will be prepared and issued by the CxA or CM. Clarifications to the minutes must be submitted within 5 days of issue, after which, the issued set becomes the official project record.

17.1.3 60% Construction Completion

At 60% construction completion stage CxA to call a separate Cx meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

1. Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
2. Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

The CxA will typically visit the site at this time to determine if progress is meeting the schedule and to identify any issues that may affect the Commissioning Process.

Meetings will be chaired by the CxA or CM; meeting minutes will be prepared and issued by the CxA or CM. Clarifications to the minutes must be submitted within 5 days of issue, after which, the issued set becomes the official project record.

17.2 INSTALLATION VERIFICATION

Installation Verifications are a systematic set of procedures intended to identify whether individual system components have been installed properly. This process occurs prior to startup of individual units of equipment and involves using “Installation Verification Check Lists" to ensure consistency in the inspections and document the process.

Installation Verifications are performed by the installing contractor. Installation Verifications provide quality control to ensure that relatively minor issues (e.g., an improperly wired sensor, a control valve installed backward) are discovered and corrected prior to systems performance testing.

The Installation Verification process is typically witnessed and verified by the TSI, however, in some cases Transportation and Infrastructure may opt to have the CxA or other representative observe and verify.

17.3 PERFORMANCE VERIFICATION

Systems Performance Verification will occur once all system components are installed, energized, programmed, balanced, and otherwise ready for operation under part- and full-load conditions. The Installation Verification Checklists, Testing-Adjusting-Balancing report will be reviewed and accepted by the Design Consultant and CxA prior to start of Performance Verification.

Testing should include each process in the sequence of operations under central and packaged equipment control, including startup, shutdown, capacity modulation, emergency and failure modes, alarms, and interlocks to other equipment.

Systems Performance Verification typically relies on testing procedures developed by the CxA specifically for the system to be tested. A wide variety of methods may be used to simulate and evaluate that the system being tested performs as expected (per the OPRs, BOD, and contract documents) in all modes of operation.

Systems Performance Verification will be performed by the installing contractor, and others, depending on the procedures outlined in the commissioning specifications and the Commissioning Manual. The Performance verifications will be witnessed by the CxA, TSIs, CM, DC, or any combination of as required. It may reveal problems with the performance of the commissioned systems and may require significant follow-up and coordination among members of the project team.

If any verification sequence cannot be completed because of seasonal limitations, lack of occupancy, or other reasons, this is recorded along with an indication of when the test will be rescheduled.

17.4 COMMISSIONING LOG

The CxA should maintain a formal and ongoing record of problems or concerns and their resolution that have been raised by any member of the project team.

This is not a substitute for the consultant's deficiency list. The consultants' list verifies that equipment has been delivered and installed as required by the specification, while the Commissioning issues log documents findings that affect the way equipment operates and systems interact.

A template for the Commissioning Log can be found in Appendix K

17.5 COMMISSIONING ACTIVITY EVALUATION

Evaluation of results is the final step. At each point in the process of Installation Verification and Performance Verification, the CxA should evaluate whether the installed systems meet the criteria for the project as set forth by in the Owner's Project Requirements and the Basis of Design documents.

Any discrepancies or deficiencies should be reported to the Owner, and the team should work collaboratively to find an appropriate resolution.

18. STEP 9 – Systems Manual

The Design Consultant shall provide a Systems Manual in addition to the O&M manuals submitted by the contractor. The Systems Manual generally focuses on operating rather than maintaining the equipment, particularly the interactions. The Systems Manual gives future operating staff the information needed to understand and optimally operate the commissioned systems.

The Systems Manual should include the following for each commissioned system:

1. Final version of the Basis of Design
2. Detailed Design Report
3. System single-line diagrams
4. As-built sequences of operations, control drawings, and original set-points
5. Operating instructions for integrated building systems
6. Recommended schedule of maintenance requirements and frequency, if not already included in the project O&M manuals
7. Recommended schedule for retesting of commissioned systems with blank test forms from the original Commissioning Manual
8. Recommended schedule for calibrating sensors and actuators
9. Contact information for design team, contractors, suppliers, etc

19. STEP 10 – Training Verification

The CxA establishes and documents training expectations and needs with the Owner. Ensure that operations staff and occupants receive this training and orientation. Pay particular attention to new or uncommon sustainable design features that could be overridden or removed because of a lack of understanding. Document that the training was completed according to the contract documents.

Have a contract in place to review operation with O&M staff and occupants, including a plan for resolution of outstanding commissioning-related issues 10 months after substantial completion. The training shall ensure:

1. Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
2. Effective on-going inspection, measurements of system performance.
3. Proper preventive maintenance, diagnosis, trouble-shooting and maintenance.
4. Ability to update documentation.
5. Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

The Contractor is responsible for supplying the following training materials to all trainees:

1. "As-Built" Contract Documents.
2. Operating Manual.
3. Maintenance Manual.
4. Testing, adjusting and balancing and performance verification reports where applicable.

Training materials to be in a format that permits future training procedures to the same degree of detail with or without the instructor.

19.1 Common Training Topics

1. General purpose of system (design intent)
2. Use of and review of O&M manuals
3. Review of control drawings and schematics
4. Review of system layout, equipment, components and controls.
5. Startup, normal operation, monitoring, shutdown, unoccupied operation, seasonal changeover, manual operation, maintenance
6. Operation, control setup and programming troubleshooting, and alarms
7. Interactions with other systems
8. Adjustments and optimizing methods for energy conservation
9. Health and safety issues
10. Special maintenance and replacement sources
11. Occupant interaction issues
12. System response to different operating conditions
13. Emergency protocols
14. Trouble-shooting diagnosis.

20. STEP 11 – Summary Commissioning Report

After Installation Verifications and performance verification has been completed, the completed forms shall be submitted to the CxA who will then assemble a commissioning report. Supporting information can be compiled as a Cx record but is not required in the summary.

The commissioning report should include the following:

1. Executive summary of the process and the results of the commissioning program, including
   a. Observations
   b. Conclusions
   c. Any major outstanding items
2. Description of commissioning process benefits
3. Owner's Project Requirements
4. Basis of Design report
5. Commissioning Plan
6. Project commissioning specifications
7. Summary of the design review process
8. Summary of the submittal review process
9. Installation Verification checklists (construction checklist)
10. Performance Verification checklists (test results forms and evaluation)
11. Summary of the O&M documentation
12. Summary of the training process
13. History of any system deficiencies identified and how they were resolved, including any outstanding issues or seasonal testing scheduled for a later date
14. Confirmation from the CxA indicating whether individual systems meet the Owner's Project Requirements, Basis of Design, and contract documents
15. Outstanding issues
16. Contractor plan for resolution within 10 months of substantial completion
17. Occupancy and operation evaluation reports
18. An evaluation of the operating condition of the systems at the time of functional test completion
19. Deficiencies that were discovered and the measures taken to correct them
20. Performance Verification test procedures and results
21. Reports documenting all Commissioning field activities as they progressed
22. A description and estimated schedule of required deferred testing

Template table of contents for the Commissioning Manual can be found Appendix D.

21. STEP 12 – 10 Month Building Review

The CxA should coordinate with the Owner and the O&M staff to review the facility and its performance within 10 months of substantial completion. All unresolved construction

deficiencies as well as any deficiencies identified in this post-occupancy review should be documented and corrected under manufacturer or contractor warranties.

The CxA review of the building operation with operations staff and occupants should identify any problems in operating the building as originally intended. Any significant issues identified by the CxA that will not be corrected should be recorded in the Systems Manual.

A sample Occupant Survey can be found in Appendix H.

22. Roles and Responsibilities

22.1 Commissioning Authority Roles and Responsibilities

1. Reviews Owner's Project Requirements, Basis of Design and design documents at all stages of submittal and provides comments to the DM
2. Records all comments as history for the project commissioning
3. Produces the Commissioning Manual for review by the DM and DC, and modifies based on their comments as necessary
4. Provides "Issued for Construction" Commissioning Manual to the DM
5. Provides guidance on the Commissioning Process, and responsibilities of Commissioning Team members
6. Reviews contractor shop drawings for related commissioning information
7. Coordinates and chairs (in person or via teleconference) the commissioning kick-off meeting and progress meetings
8. Prepares and distributed the meeting agenda and minutes
9. Attends when necessary Installation Verification
10. Reviews completed Installation Verification checklists and signs off
11. Attends Performance Verification and signs off on check lists
12. Attends owner training sessions
13. Verifies that training is complete
14. Reviews completed Cx manual as submitted by the contractor
15. Prepares Summary Commissioning Report and submits to the CM for the Owner
16. Prepares letter for CM indicating acceptance of the completed commissioning activities
17. Verifies that seasonal or deferred Commissioning is completed
18. Coordinates 10 month building review and issues occupant survey

22.2 Design Manager Roles and Responsibilities

1. Reviews Owner's Project Requirements, Basis of Design and design documents at all stages of submittal. Compiles all comments from all reviewers and submits to document originator
2. Submits all documentation required by the CxA in a timely manner
3. Identifies Cx team members
4. Provides a list of equipment and systems included in the design to the CxA for inclusion in preliminary manual
5. Reviews Cx manual in draft and final revisions. Provides comments to the CxA as necessary on the Commissioning Manual
6. Forwards the Cx Manual for review by the DC, receives comments and issues them to the CxA
7. Ensures that the Cx Manual is issued with the tender documents
8. Issues IFC Cx Manual to the CM
9. Reviews contractor shop drawings and provide comments to the CM
10. Attends Cx kick-off meeting during the design phase
11. Attends commissioning progress meetings as required

12. Attends Installation Verification as required
13. Attends Cx Performance Verification or provides representative
14. Attends training sessions or sends representative knowledgeable in the design
15. Assists with 10 month building review

22.3 Owner / Building Manager Roles and Responsibilities

1. Produces the Owner Project Requirements and submits to the Design Manager
2. Reviews the Basis of Design developed by the Design Consultant and provides comments to the Design Manager
3. Reviews all design documents and provides comments to the Design Manager
4. Coordinates maintenance staff participation in Cx activities
5. Reviews O&M documentation and attends training
6. Attends all training sessions
7. Receives and retains a copy of the Commissioning Summary Report
8. Provides maintenance representatives to facilitate the 10 month building review as necessary
9. Attends commissioning meetings as necessary

22.4 Construction Manager Roles and Responsibilities

1. Main contact for CxA during construction phase
2. Distributes “Issued for Construction” Cx Manual to GC
3. Notifies CxA of any Cx related issues raised during construction (i.e. change Orders)
4. Provides times during any project meetings to discuss Cx with the entire team
5. Attends Cx meetings (construction phase)
6. Coordinates Cx schedule for Installation Verification and Performance Verification with GC and ensures all TI representatives are available to witness testing as required for Installation Verification and Performance Verification
7. Attend Performance Verification
8. Ensures Cx Team is following/completing Cx Manual
9. Ensures a copy of the Systems manual received from the Design Consultant is distributed as necessary, particularly to the CxA for inclusion in the Summary Commissioning Report.
10. Coordinates training schedules, and arranges for video recording of sessions if required
11. Reviews project record documents
12. Ensures that O&M manuals, maintenance materials, as-built drawings and warranties have been submitted and reviewed
13. Provides CxA with reviewed As Built documents, O&M Manuals, and Warranties for inclusion in the Summary Commissioning Report
14. Receives the completed Commissioning Manual from the GC and submits to the CxA for review
15. Receives the Summary Commissioning Report from the CxA and submits to the Owner
16. Coordinates 10 month building review and issues occupant survey
17. Verifies that all maintenance materials, spare parts and tools are received from the GC as per specifications

22.5 General Contractor Roles and Responsibilities

1. Maintains as-built drawings on site during construction
2. Submits shop drawing in accordance with the specifications
3. Ensures the Commissioning Manual is on site and being completed and kept up to date by all sub-trades
4. Executes the Cx process ensuring that sub-trades perform their responsibilities and integrate Cx into the construction process
5. Ensures equipment manufacturers and vendors provide documentation to facilitate the Commissioning work and perform startups
6. Coordinates and schedules Cx activities, submits schedule for review and comment by TI staff
7. Conducts Installation Verification and signs off checklists
8. Provides written confirmation all systems are operational prior to start of Performance Verification
9. Conducts Performance Verification with all required Commissioning Team members present
10. Ensures that all required personal are available for the verification
11. Maintains an up to date version of the Cx manual on site with checklists completed on installed/operational systems
12. Provides all required training,
    a. Coordinates location, schedule
    b. Provides facilities (location, materials)
    c. Ensure qualified factory trained technicians are available to facilitate training
    d. Provides copies of all training material
13. Obtains occupancy approvals/permits
14. Submits completed manual to Construction Manager
15. Provides the following information for inclusion in the Commissioning Summary Report
    a. Training Records
    b. Operation and Maintenance Manuals
    c. Warranties
    d. Completed commissioning Checklists
    e. List of spare parts turned over
16. Supplies maintenance materials and tools as per specification
17. Attends all commissioning meetings
18. Provides services for corrective actions for issued uncovered in the 10 Month Building Review.

22.6 Project Coordinator Roles and Responsibilities

If there is no Project Coordinator assigned to the project, then these duties are completed by the Construction Manager.

1. Attends Installation Verification and Performance Verification demonstrations
2. Ensures Cx manual is on site and kept up to date by the GC
3. Verifies maintenance materials are provided by the GC as per the contract documents
4. Ensures GC is maintaining as-built drawings on site during construction
5. Attends training sessions as necessary and directed by the Construction Manager

6. Attends all commissioning meetings

22.7 Technical Services Inspector Roles and Responsibilities

1. Attends Installation Verification and Performance Verification for equipment within their discipline
2. Signs off on commissioning checklists within their discipline
3. Attends training sessions as necessary and directed by the Construction Manager
4. Attends all commissioning meetings

22.8 Design Consultant Roles and Responsibilities

1. Reviews the Owner Project Requirements and provides comment to the Design Manager
2. Produces the Basis of Design and submits to the Design Manager for review and comment. Revise as necessary based on comments and changes in Owner Project Requirements
3. Develops system descriptions and forwards to the CxA, for inclusion in the Commissioning Manual
4. Reviews drafts of the Commissioning Manual, including the installation and Performance Verification checklists, and provides comments to the Design Manager,
5. Provides project narrative for inclusion in the Commissioning Manual
6. The Consultant shall provide to the Commissioning Authority a complete list of ALL equipment and information required to populate the commissioning checklists with the following information:
    a. identification number
    b. location
    c. type, proposed manufacture, make, model
    d. operating parameter (max, normal, min)
    e. electrical requirements
    f. control comments
    g. other pertinent information
7. Incorporates commissioning specification into the project documents
8. Reviews contractor shop drawing submittals
9. Attends periodic site visits to ensure systems meet the design intent and operate as outline in the specifications
10. Attends and signs off checklist for Installation Verification
11. Attends Performance Verification and signs off on checklists for the appropriate discipline
12. Develops and submits Systems Manuals to the Construction Manager (these will be included in the Commissioning Summary Report)
13. Provides system overview during training
14. Attends training as required
15. Attends commissioning meetings
16. Attends 10 month building review activities

23. Communications Plan / Deliverables

The following table lists all communications and deliverables with respect to Commissioning for the project. The purpose of this list is to summarize expected communications and deliverables for a typical project. This may be modified to be project specific as required.

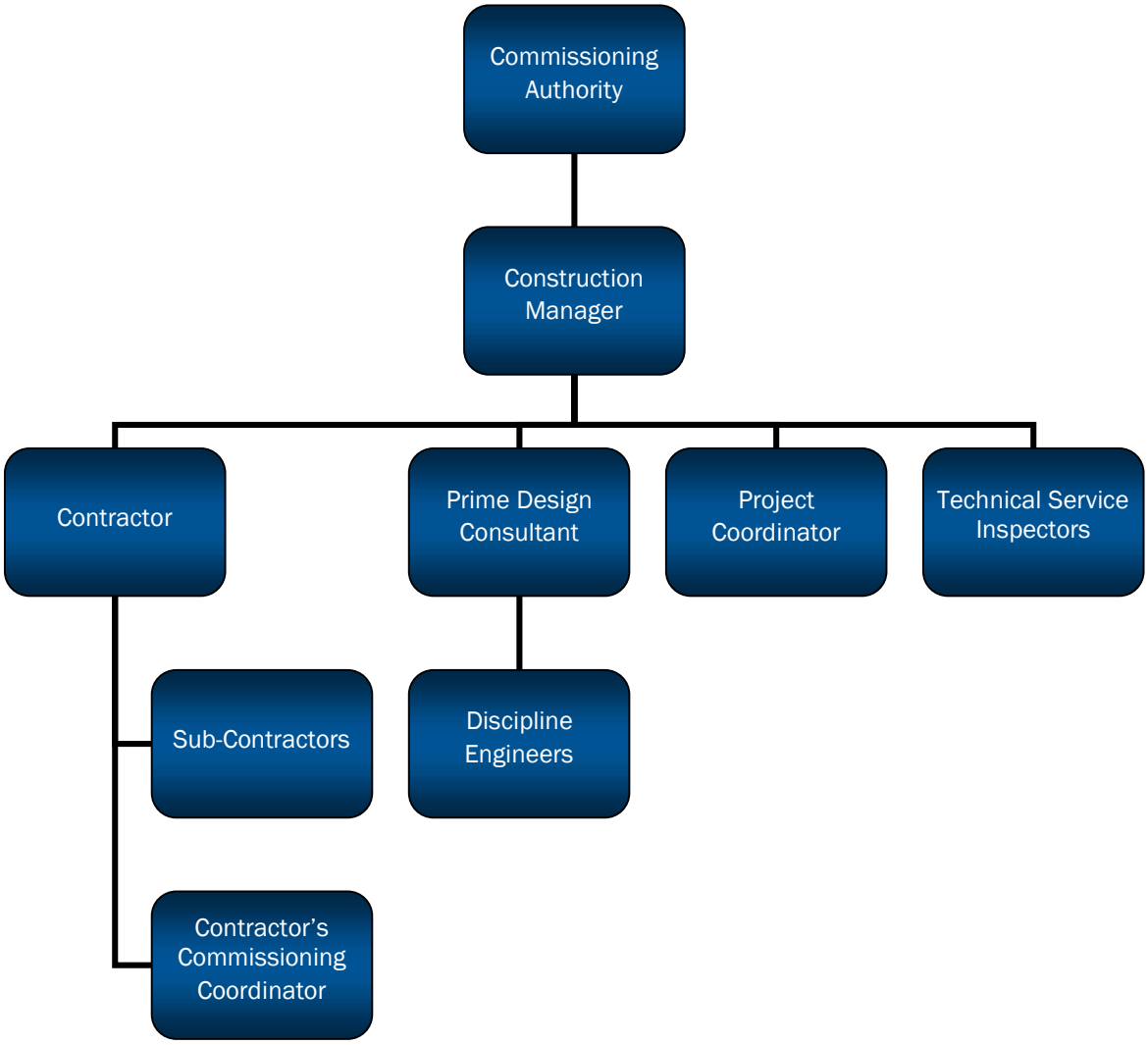
Communication O = Owner R = Recipient P = Participant C = Recipient & Commenter	When Daily Weekly Monthly Bi-Monthly Yearly	How Email PDF Conf. Call Tech Doc FTP etc	Commissioning Authority	Design Manager	TI Technical Reviewers	Owner	Prime Consultant	Construction Manager	Contractor	Sub-Contractors	Contractor Cx Coordinator	Project Coordinator	Technical Service Inspectors
<u>Planning /Programming Phase</u>													
Owner Project Requirements				R		O							
<u>Concept Design and Design Development Phase</u>													
Owner Project Requirements			C, R	C, R	R	O	R						
Owner Project Requirements Comment Log				O									
Basis of Design			C, R	C, R	R	C, R	O						
Basis of Design Comment Log				O									
Systems Descriptions			R				O						
Equipment Lists			R	P			O						
Commissioning Manual			O	C	C	C							
Commissioning Manual Comment Log			O										
Concept Report			C	C, R	C	C	O						
Concept Report Comment Log				O									
Design Development Report			C	C, R	C	C	O						
Design Development Report, Drawings and Specifications Comment Log				O									
Drawings			C	C, R	C	C	O						
Specifications			C	C, R	C	C	O						
<u>Detailed Design Phase</u>													
Owner Project Requirements			C, R	C, R	R	O	R						
Basis of Design			C, R	C, R	R	C, R	O						
Commissioning Manual			O	C	C	C	C						
Concept Report			C	C, R	C	C	O						

Communication O = Owner R = Recipient P = Participant C = Recipient & Commenter	When Daily Weekly Monthly Bi-Monthly Yearly	How Email PDF Conf. Call Tech Doc FTP etc	Commissioning Authority	Design Manager	TI Technical Reviewers	Owner	Prime Consultant	Construction Manager	Contractor	Sub-Contractors	Contractor Cx Coordinator	Project Coordinator	Technical Service Inspectors
Design Development Report			C	C, R	C	C	O						
Drawings			C	C, R	C	C	O						
Specifications			C	C, R	C	C	O						
Design Review Comments			C	O	C	C	R						
Tender Documents													
Drawings			R	R		R	O	R	R	R	R	R	R
Specifications			R	R		R	O	R	R	R	R	R	R
Commissioning Manual			O	R		R	R	R	R	R	R	R	R
Addendums			R			R	O	R	R	R	R	R	R
During Construction													
Shop Drawings			C	C	C		C	C	O			C	C
Commissioning Manual			O					R	R				
Commissioning Meeting Agenda			O	R		R	R	R	R	R	R	R	R
Commissioning Meeting Minutes			O	R		R	R	R	R	R	R	R	R
Commissioning Meetings			O	P		P	P	P	P	P	P	P	P
Project Construction Schedule			R	R		P		P	O				
Commissioning Schedule (part of Project Schedule)			R	R		P		P	O				
Commissioning Log			O	P	P	R	R		R				
Systems Manual			R	R			O	R					
O&M Manuals			R	R		R		R	O				
Training Agenda			C, R	R		P	R	P	O	R	R	R	R
Training Schedule			R	R		P	R	P	O		R	R	R
Training Records			R			R		R	O				
Summary Commissioning Report			O	R		R	R	R					
Site Inspection Reports			R	R		R		R	R				O
Deficiency Lists			P	P		P	P	O	R			P	P
Training Sessions			P	P	P	P	P	P	O	P	P	P	P
Prior to Substantial Completion													
Value of Commissioning Forms			O					R	R				
Release for Use Forms			O					R	R				
Systems Manual			O					R	R				

Communication O = Owner R = Recipient P = Participant C = Recipient & Commenter	When Daily Weekly Monthly Bi-Monthly Yearly	How Email PDF Conf. Call Tech Doc FTP etc	Commissioning Authority	Design Manager	TI Technical Reviewers	Owner	Prime Consultant	Construction Manager	Contractor	Sub-Contractors	Contractor Cx Coordinator	Project Coordinator	Technical Service Inspectors
Issues Log			O					R	R				
<u>Occupancy</u>													
10 Month Building Review			O			P	P	P					
Occupant Survey			O			P	P	P					
Maintenance Program			P			O	P	P					
Commissioning Summary Report			O			R		R					
Re-Commissioning Plan			O			R		R					

24. Commissioning Reporting Structure

For the purposes of Commissioning the following structure shall be used



25. Typical Schedule of Commissioning Activities

The Contractor is responsible for developing a detailed schedule of commissioning activities and submitting it to the Construction Manager shortly after start of construction. Information to be included on the schedule is:

1. Project name, location and number
2. Detailed Task
3. Resources (all those required for the verification)
4. Duration
5. Start and end times
6. Installation Verifications
7. Performance Verifications

A sample contractor schedule can be found Appendix I, this can be used as a level of expectation of the amount of detail required on the submitted schedule.

26. Maintenance Program

With assistance of the manufacturer the Contractor shall develop a written maintenance program and submit to CxA for approval before implementation.

Appendix A - Owner's Project Requirements Table of Contents

Owner Project Requirements

1. Introduction
2. Project Narrative
3. Owner and User Requirements
    - 3.1 Primary Purpose
    - 3.2 Form of Facility
    - 3.3 Program
        - 3.3.1 Occupancy & Schedules
        - 3.3.2 Functional uses
        - 3.3.3 Expansion
        - 3.3.4 Flexibility
        - 3.3.5 Views and Access
    - 3.4 Financial Considerations
        - 3.4.1 Capital Cost
        - 3.4.2 Operational Costs
    - 3.5 Project Planning and Design Considerations
        - 3.5.1 Schedule
        - 3.5.2 Life of Facility
        - 3.5.3 Quality of Materials and Assembly
    - 3.6 Community Interactions and Integration
    - 3.7 Training Requirements
    - 3.8 Owner and Operators
    - 3.9 Other
4. Specific Objectives
    - 4.1 Codes and Standards
    - 4.2 Accessibility
    - 4.3 Structure
    - 4.4 Architectural Considerations
        - 4.4.1 Acoustics
        - 4.4.2 Aesthetics
        - 4.4.3 Space Design
            - 4.4.3.1 Use
            - 4.4.3.2 Occupancy
            - 4.4.3.3 Schedules
            - 4.4.3.4 Lighting
            - 4.4.3.5 Temperature
            - 4.4.3.6 Humidity
            - 4.4.3.7 Acoustics
            - 4.4.3.8 Air quality
            - 4.4.3.9 Ventilation
            - 4.4.3.10 User Control
        - 4.4.4 Envelope
        - 4.4.5 Partitions
        - 4.4.6 Finishes
        - 4.4.7 Afterhours Use
    - 4.5 Energy Efficiency Goals – General
    - 4.6 Energy Efficiency Goals – Specific

Appendix B - Room Data Sheet Template

Room data Sheet

Project Name:		Project Number:	
Revision:		Date:	
Room Name		Room Number	

General Information

Space Name:		Net area (m2)	
Number of Spaces:		Ceiling Height (m)	
Periods of Use:		Number of Occupant	

Functional Requirements

Function / Activity:	
Important Adjacent Spaces:	
Important Access / Security Points	

Separations

Ratings	Walls	Floors	Ceilings
Fire			
Sound			

Architectural

Materials and Finishes	Walls	Floors	Ceilings
Construction			
Finish			
Flame Spread			
Door Construction	**Material / Finish**	**Fire Rating**	**Sound Rating**
Door			
Door Frame			
Door Hardware	**Style**	**Finish**	
Lockset			
Hinges			
Gasketing			
Other			

Fenestration

Orientation	Glazing

Orientation	Glazing

Equipment:

Built Ins:
Furnishings:

Singe:

Structural

Vibration Control	

Room data Sheet

Project Name:		Project Number:	
Revision:		Date:	
Room Name		Room Number	
Special Pads			
Floor Loading			

Mechanical

Room Control	Level of Control		
Heating		Fresh air	
Cooling		Humidity Control	
Air Filtration		Room Pressure	

Plumbing Fixtures	Type	Number	Hot Water	Cold Water
Lavatories				
Water Closets				
Other				

Sprinklers:			
Sprinkler Type:		Head:	

Electrical

Power Outlets	Housekeeping	Computer	Equipment	
Voltage 120/240				
Isolated Ground				
Surge Protection				
Lighting	Ambient	Task	Fire Alarm	Emergency
Lighting Level				
Fixture Type				
Special Requirements				
Level of Control				
Communications				
Telephone		Public Address		
Computers		Other		
Special				
Sound masking		Intrusion Alarm		
Surveillance Cameras		Doors		
Fire Safety	Type	Class		
Fire Alarm				
Heat Detectors				
Smoke Detectors				

Appendix C - Basis of Design Table of Contents

Basis of Design

1. Project Narrative (include Computer Generated Rendering)
2. Faculty Program
    - 2.1 Program Narrative
    - 2.2 Program Design Comparisons
    - 2.3 Summary of Departmental Spaces
    - 2.4 Gross Area Comparison
    - 2.5 Site Infrastructure
        - 2.5.1 Site Earth Works
        - 2.5.2 Water Mains
        - 2.5.3 Sanitary Sewer Mains
        - 2.5.4 Site Storm Drainage
        - 2.5.5 Manholes and Catch Basins
        - 2.5.6 Hard and Soft Landscaping
        - 2.5.7 Fire Water Supply and Hydrants
        - 2.5.8 Site Water Utility Distribution Piping
        - 2.5.9 Public Sanitary Utility Sewerage Piping
        - 2.5.10 Utility Drainage Field
        - 2.5.11 Geothermal Vertical Borehole Heat Exchanger
    - 2.6 Building Envelope
        - 2.6.1 Foundations
        - 2.6.2 Structural Framing
        - 2.6.3 Concrete Slabs on Grade/Suspended Slabs
        - 2.6.4 Thermal and Moisture Protection
        - 2.6.5 Roof Assembly
        - 2.6.6 Exterior Wall Assemblies
        - 2.6.7 Doors, Windows and Skylights
        - 2.6.8 Door Operators
        - 2.6.9 Entrances and Exits
        - 2.6.10 Overhead Doors
        - 2.6.11 Air Leakage Control
    - 2.7 Barrier Free
        - 2.7.1 Barrier Free Path of Travel (Exterior and Interior)
        - 2.7.2 Barrier Free Washrooms
            - 2.7.2.1 Water Closets
            - 2.7.2.2 Lavatories
        - 2.7.3 Shower Rooms
            - 2.7.3.1 Shower Stalls
            - 2.7.3.2 Shower Trim
        - 2.7.4 Automatic Door Operators
        - 2.7.5 Counter Spaces
        - 2.7.6 Parking Spaces and Walkways
    - 2.8 Fire and Life Safety
        - 2.8.1 Code Reviews (NRCC & NFPA Life Safety)
        - 2.8.2 Occupant Load Calculations
        - 2.8.3 Fire Commissioner's Form

2.12.4 Domestic Water Booster Pumps
2.12.5 Sanitary Sewer
2.12.6 Plumbing Vents
2.12.7 Storm Sewer
2.12.8 Non-potable Water System

2.13 Medical Gas
2.13.1 Medical Air System
2.13.2 Medical Vacuum System
2.13.3 Medical Oxygen System
2.13.4 Oxygen Generation
2.13.5 Nitrous Oxide
2.13.6 Nitrogen
2.13.7 Carbon Dioxide
2.13.8 Medical Test Gas Mixtures
2.13.9 Medical Vacuum
2.13.10 Waste Anesthesia Gas Disposal

2.14 HVAC
2.14.1 Steam Generators- Boilers
2.14.2 Electric Boilers
2.14.3 Hot Water Generator-Boilers
2.14.4 Hot Water Heating System
2.14.5 HVAC Water Treatment
2.14.6 Ground Source Heat Pump
2.14.7 Ground Loop Heat Exchanger
2.14.8 Water Source Heat Pumps
2.14.9 Air Source Heat Pump
2.14.10 Chilled Water System-Chillers
2.14.11 Chilled Water System
2.14.12 Humidification
2.14.13 Air Handling Systems
2.14.14 Air Handling Units
2.14.15 Fans
2.14.16 Reheat Coils
2.14.17 VAV Boxes
2.14.18 Space Pressure
2.14.19 Isolation Room Systems
2.14.20 Heat Recovery Systems
2.14.21 Hydronic Pumps
2.14.22 Dry Fluid Cooler
2.14.23 Chillers
2.14.24 Heat Exchangers
2.14.25 Radiation Heaters
2.14.26 Unit Heaters
2.14.27 In-Floor Radiant Heating System

2.15 Controls
2.15.1 DDC Systems
2.15.2 Energy Management System

- 2.15.3 System Architecture
- 2.15.4 Existing Systems
- 2.15.5 Control Sequences
- 2.15.6 Zone Control
- 2.15.7 Heater Control
- 2.15.8 Field Control Devices

2.16 Electrical-Distribution

- 2.16.1 Pad mount Switchgear
- 2.16.2 Exterior Load Break Switches
- 2.16.3 Interior Switchgear
- 2.16.4 Air Circuit Breakers
- 2.16.5 Conductors
- 2.16.6 Interior Feeders
- 2.16.7 Pad mount Distribution Transformers
- 2.16.8 Dry-Type Transformers
- 2.16.9 Lightning Arrestor
- 2.16.10 Overhead Service
- 2.16.11 Underground Service
- 2.16.12 Electric Load Bank
- 2.16.13 Cable Tray Systems
- 2.16.14 Power Factor Capacitors
- 2.16.15 Service Entrance Equipment
- 2.16.16 Motor Control Centres
- 2.16.17 Disconnect/Safety Switches
- 2.16.18 Equipment Enclosure
- 2.16.19 Splitters
- 2.16.20 Junction Boxes
- 2.16.21 Wiring Devices
- 2.16.22 Circuit Breakers
- 2.16.23 Conduits
- 2.16.24 Motor Starters
- 2.16.25 Grounding
- 2.16.26 Contactors
- 2.16.27 Electrical Outlets
- 2.16.28 Electric Heating
- 2.16.29 Snow Melt Cables
- 2.16.30 Metering
- 2.16.31 Electric Vehicle (EV) Charging Stations
- 2.16.32 Variable Frequency Drives
- 2.16.33 De-Stratification Fans
- 2.16.34 Power Generation Diesel
- 2.16.35 Automatic Transfer Switches
- 2.16.36 Ground Fault Circuit Interrupters - Class “A”
- 2.16.37 Conduits

2.17 Electrical-Lighting

- 2.17.1 Lighting
- 2.17.2 Exterior Transformers

- 2.17.3 Lighting Panel Boards
- 2.17.4 Interior Lighting
- 2.17.5 Exterior Lighting
- 2.17.6 Addressable Lighting Control System
- 2.17.7 Exit Signs
- 2.17.8 Roadway Lighting
- 2.17.9 Lighting Control Devices – Occupancy Sensors
- 2.17.10 Lighting Control Devices - LED Dimming
- 2.17.11

2.18 Electrical-Emergency Power

- 2.18.1 Emergency Power Generation
- 2.18.2 Transfer Switches
- 2.18.3 Generator Switch Board
- 2.18.4 Ventilation
- 2.18.5 Fuel System
- 2.18.6 Emergency Power Distribution

2.19 Communications, Data and Security

- 2.19.1 Intercom System
- 2.19.2 Public Address System
- 2.19.3 Nurse Call System
- 2.19.4 Central Clock System
- 2.19.5 Central Dictation
- 2.19.6 Television System
- 2.19.7 Security System Card Access
- 2.19.8 Security System- CCTV
- 2.19.9 Intrusion Detection
- 2.19.10 Telephone Systems
- 2.19.11 Assistive Listening Systems
- 2.19.12 Data Cable Systems
- 2.19.13 Uninterruptible Power Supply
- 2.19.14 Multi-purpose Room Sound System
- 2.19.15 Emergency Pull Cord System
- 2.19.16 Sustainability Management System – Public Interface
- 2.19.17 Sustainability Management System – Sensors & Meters
- 2.19.18 Door Hardware Wiring

3. LEED

3.1 LEED Scorecard

3.2 Sustainable Sites

- 3.2.1 Perquisite 1 Erosion & Sedimentation Control
- 3.2.2 Credit 1 Site Selection
- 3.2.3 Credit 2 Development Density
- 3.2.4 Credit 3 Redevelopment of Contaminated Sites
- 3.2.5 Credit 4 Alternative Transportation
- 3.2.6 Credit 5 Reduced Site Disturbance
- 3.2.7 Credit 6 Storm water Management
- 3.2.8 Credit 7 Heat Island Effect
- 3.2.9 Credit 8 Light Pollution Reduction

- 3.3 Water Efficiency
  - 3.3.1 Credit 1 Water Efficient Landscaping
  - 3.3.2 Credit 2 Innovative Wastewater Technologies
  - 3.3.3 Credit 3 Water Use Reduction
- 3.4 Energy & Atmosphere
  - 3.4.1 Prerequisite 1 Fundamental Building Systems Commissioning
  - 3.4.2 Prerequisite 2 Minimum Energy Performance
  - 3.4.3 Prerequisite 3 CFC Reduction in HVAC&R Equipment and Elimination of Halons
  - 3.4.4 Credit 1 Optimize Energy Performance
  - 3.4.5 Credit 2 Renewable Energy Performance
  - 3.4.6 Credit 3 Best Practice Commissioning
  - 3.4.7 Credit 4 Ozone Protection
  - 3.4.8 Credit 5 Measurement and Verification
  - 3.4.9 Credit 6 Green Power
- 3.5 Materials & Resources
  - 3.5.1 Prerequisite 1 Storage & Collection of Recyclables
  - 3.5.2 Credit 1 Building Reuse
  - 3.5.3 Credit 2 Construction Waste Management
  - 3.5.4 Credit 3 Resource Reuse
  - 3.5.5 Credit 4 Recycled Content
  - 3.5.6 Credit 5 Regional Materials
  - 3.5.7 Credit 6 Rapidly Renewable Materials
  - 3.5.8 Credit 7 Certified Wood
- 3.6 Credit 8 Durable Building
  - 3.6.1 Indoor Environmental Quality
  - 3.6.2 Prerequisite 1 Minimum IAQ Performance
  - 3.6.3 Prerequisite 2 Environmental Tobacco Smoke (ETS) Control
  - 3.6.4 Credit 1 Carbon Dioxide (CO2) Monitoring
  - 3.6.5 Credit 2 Ventilation Effectiveness
  - 3.6.6 Credit 3 Construction IAQ Management Plan
  - 3.6.7 Credit 4 Low-Emitting Materials
  - 3.6.8 Credit 5 Indoor Chemical & Pollutant Source Control
  - 3.6.9 Credit 6 Controllability of Systems
  - 3.6.10 Credit 7 Thermal Comfort
  - 3.6.11 Credit 8 Daylight & Views
- 3.7 Innovation & Design Process
  - 3.7.1 Credit 1 Innovation in Design
  - 3.7.2 Credit 2 LEED Accredited Professional

4. Furniture & Equipment
   - 4.1 Owner Supplied and Installed (include Product Literature)
   - 4.2 Owner Supplied, Contractor Installed (include Product Literature)
   - 4.3 Contractor Supplied and Installed (include Product Literature)
5. Annexes
   - 5.1 Room Data Sheets
   - 5.2 Geotechnical Report
   - 5.3 Energy Simulation Report

5.4 Ground Source Heat Exchanger Sizing
5.5 MNECB Checklist
5.6 Commissioning Plan
5.7 Specification Index
5.8 List of Drawings
5.9 Drawings (separate cover)
5.10 Costing Studies (separate cover)

Appendix D - Commissioning Manual Template

Commissioning Manual

1. Purpose of the Commissioning Plan
2. Commissioning Overview
    - 2.1 Commissioning Summary Report Intent
3. General Building Information
4. Abbreviations and Definitions
5. Commissioning Team Information
    - 5.1 Reporting structure
    - 5.2 Commissioning Authority Roles and Responsibilities
    - 5.3 Design Manager Roles and Responsibilities
    - 5.4 Owner / Building Manager Roles and Responsibilities
    - 5.5 Construction Manager Roles and Responsibilities
    - 5.6 General Contractor Roles and Responsibilities
    - 5.7 Project Coordinator Roles and Responsibilities
    - 5.8 Technical Services Inspector Roles and Responsibilities
    - 5.9 Design Consultant Roles and Responsibilities
6. Specifications and Commissioning
7. Commissioning Process
    - 7.1 General Issues
    - 7.2 Owner's Project Requirements and Basis of Design
    - 7.3 Commissioning Kick off Meeting
    - 7.4 Execution of Functional testing Procedures
    - 7.5 Short-term Diagnostic Monitoring
    - 7.6 Training
    - 7.7 Warranty Period
    - 7.8 Sample Commissioning Schedule
    - 7.9 Commissioning Activities
8. Submittals / Deliverables
    - 8.1 Submittal Review Procedure
    - 8.2 Schedule
    - 8.3 Prior to Cx Activities
    - 8.4 Prior to Application for Substantial Completion
    - 8.5 Site Inspections and Observations
    - 8.6 Installation Verification Checklists and Procedures
    - 8.7 Performance Verification Checklists and Procedures
    - 8.8 Operation and Maintenance Manuals
    - 8.9 Training Records
    - 8.10 Commissioning Report
9. Project Narrative
10. Systems Descriptions
    - 10.1 Site Infrastructure
        - 10.1.1 Site Earth Works
        - 10.1.2 Water Mains
        - 10.1.3 Sanitary Sewer Mains
        - 10.1.4 Site Storm Drainage
        - 10.1.5 Manholes and Catch Basins

10.1.6 Hard and Soft Landscaping
10.1.7 Fire Water Supply and Hydrants
10.1.8 Site Water Utility Distribution Piping
10.1.9 Public Sanitary Utility Sewerage Piping
10.1.10 Utility Drainage Field
10.1.11 Geothermal Vertical Borehole Heat Exchanger

10.2 Building Envelope
10.2.1 Foundations
10.2.2 Structural Framing
10.2.3 Concrete Slabs on Grade/Suspended Slabs
10.2.4 Thermal and Moisture Protection
10.2.5 Roof Assembly
10.2.6 Exterior Wall Assemblies
10.2.7 Doors, Windows and Skylights
10.2.8 Door Operators
10.2.9 Entrances and Exits
10.2.10 Overhead Doors
10.2.11 Air Leakage Control

10.3 Barrier Free
10.3.1 Barrier Free Path of Travel (Exterior and Interior)
10.3.2 Barrier Free Washrooms
10.3.2.1 Water Closets
10.3.2.2 Lavatories
10.3.3 Shower Rooms
10.3.3.1 Shower Stalls
10.3.3.2 Shower Trim
10.3.4 Automatic Door Operators
10.3.5 Counter Spaces
10.3.6 Parking Spaces and Walkways

10.4 Fire and Life Safety
10.4.1 Code Reviews (NRCC & NFPA Life Safety)
10.4.2 Occupant Load Calculations
10.4.3 Fire Commissioner's Form
10.4.4 Fire Separations
10.4.5 Escape Routes within Facility
10.4.6 Emergency Lighting
10.4.7 Wet Pipe sprinkler System
10.4.8 Dry pipe Sprinkler System
10.4.9 Wet Chemical Fire Suppression System
10.4.10 Clean Agent Fire Suppression System
10.4.11 Standpipes
10.4.12 Pre-Action Systems
10.4.13 Deluge Systems
10.4.14 Pressurization/Smoke Control
10.4.15 Fire Alarm
10.4.16 Fire Extinguishers
10.4.17 Fire Pumps

- 10.4.18 Exit Lighting Systems
- 10.4.19 Emergency Lighting Systems

10.5 Fit-Up and Finishes
- 10.5.1 Acoustical Performance
- 10.5.2 Room Fit-up and Finishes
  - 10.5.2.1 Millwork
  - 10.5.2.2 Interior Doors
  - 10.5.2.3 Folding Divider Partition
  - 10.5.2.4 Specialties
- 10.5.3 Furniture and Equipment
  - 10.5.3.1 Owner Supplied & Owner Installed
  - 10.5.3.2 Owner Supplied & Contractor Installed
  - 10.5.3.3 Contractor Supplied & Contractor Installed
- 10.5.4 Gymnasium Equipment
- 10.5.5 Residential Appliance

10.6 Food Services and Laundry
- 10.6.1 Kitchen Equipment
- 10.6.2 Pre-Fabricated Walk-in Freezers and Coolers
- 10.6.3 Cooler/Freezers Heat Recovery
- 10.6.4 Kitchen Ventilation
- 10.6.5 Laundry equipment
- 10.6.6 Laundry Heat Recovery

10.7 Conveying Systems
- 10.7.1 Fire Services Elevator
- 10.7.2 Elevators
- 10.7.3 Patient Lifts
- 10.7.4 Hydraulic Lift
- 10.7.5 Elevating Docks
- 10.7.6 Wheel Chair Lifts

10.8 Plumbing
- 10.8.1 Plumbing Fixtures
- 10.8.2 Domestic Water System
- 10.8.3 Domestic Water Treatment
- 10.8.4 Domestic Water Booster Pumps
- 10.8.5 Sanitary Sewer
- 10.8.6 Plumbing Vents
- 10.8.7 Storm Sewer
- 10.8.8 Non-potable Water System

10.9 Medical Gas
- 10.9.1 Medical Air System
- 10.9.2 Medical Vacuum System
- 10.9.3 Medical Oxygen System
- 10.9.4 Oxygen Generation
- 10.9.5 Nitrous Oxide
- 10.9.6 Nitrogen
- 10.9.7 Carbon Dioxide
- 10.9.8 Medical Test Gas Mixtures

- 10.9.9 Medical Vacuum
- 10.9.10 Waste Anesthesia Gas Disposal

10.10 HVAC

- 10.10.1 Steam Generators- Boilers
- 10.10.2 Electric Boilers
- 10.10.3 Hot Water Generator-Boilers
- 10.10.4 Hot Water Heating System
- 10.10.5 HVAC Water Treatment
- 10.10.6 Ground Source Heat Pump
- 10.10.7 Ground Loop Heat Exchanger
- 10.10.8 Water Source Heat Pumps
- 10.10.9 Air Source Heat Pump
- 10.10.10 Chilled Water System-Chillers
- 10.10.11 Chilled Water System
- 10.10.12 Humidification
- 10.10.13 Air Handling Systems
- 10.10.14 Air Handling Units
- 10.10.15 Fans
- 10.10.16 Reheat Coils
- 10.10.17 VAV Boxes
- 10.10.18 Space Pressure
- 10.10.19 Isolation Room Systems
- 10.10.20 Heat Recovery Systems
- 10.10.21 Hydronic Pumps
- 10.10.22 Dry Fluid Cooler
- 10.10.23 Chillers
- 10.10.24 Heat Exchangers
- 10.10.25 Radiation Heaters
- 10.10.26 Unit Heaters
- 10.10.27 In-Floor Radiant Heating System

10.11 Controls

- 10.11.1 DDC Systems
- 10.11.2 Energy Management System
- 10.11.3 System Architecture
- 10.11.4 Existing Systems
- 10.11.5 Control Sequences
- 10.11.6 Zone Control
- 10.11.7 Heater Control
- 10.11.8 Field Control Devices

10.12 Electrical-Distribution

- 10.12.1 Pad mount Switchgear
- 10.12.2 Exterior Load Break Switches
- 10.12.3 Interior Switchgear
- 10.12.4 Air Circuit Breakers
- 10.12.5 Conductors
- 10.12.6 Interior Feeders
- 10.12.7 Pad mount Distribution Transformers

10.12.8 Dry-Type Transformers
10.12.9 Lightning Arrestor
10.12.10 Overhead Service
10.12.11 Underground Service
10.12.12 Electric Load Bank
10.12.13 Cable Tray Systems
10.12.14 Power Factor Capacitors
10.12.15 Service Entrance Equipment
10.12.16 Motor Control Centres
10.12.17 Disconnect/Safety Switches
10.12.18 Equipment Enclosure
10.12.19 Splitters
10.12.20 Junction Boxes
10.12.21 Wiring Devices
10.12.22 Circuit Breakers
10.12.23 Conduits
10.12.24 Motor Starters
10.12.25 Grounding
10.12.26 Contactors
10.12.27 Electrical Outlets
10.12.28 Electric Heating
10.12.29 Snow Melt Cables
10.12.30 Metering
10.12.31 Electric Vehicle (EV) Charging Stations
10.12.32 Variable Frequency Drives
10.12.33 De-Stratification Fans
10.12.34 Power Generation Diesel
10.12.35 Automatic Transfer Switches
10.12.36 Ground Fault Circuit Interrupters - Class “A”
10.12.37 Conduits
10.12.38

10.13 Electrical-Lighting
10.13.1 Lighting
10.13.2 Exterior Transformers
10.13.3 Lighting Panel Boards
10.13.4 Interior Lighting
10.13.5 Exterior Lighting
10.13.6 Addressable Lighting Control System
10.13.7 Exit Signs
10.13.8 Roadway Lighting
10.13.9 Lighting Control Devices – Occupancy Sensors
10.13.10 Lighting Control Devices - LED Dimming
10.13.11

10.14 Electrical-Emergency Power
10.14.1 Emergency Power Generation
10.14.2 Transfer Switches
10.14.3 Generator Switch Board

Appendix B: Architectural Performance Verification
Appendix C: Civil Equipment and Installation Verification
Appendix D: Civil Performance Verification
Appendix E: Mechanical Equipment and Installation
Appendix F: Mechanical Performance Verification
Appendix G: Electrical Equipment and Installation
Appendix H: Electrical Performance and Installation

Appendix E – Sample Checklists

CIVIL INSTALLATION VERIFICATION

APPENDIX C

Project: PROJECT
Project #: NUMBER
Location: LOCATION
Form #: CE-I01
Date: DATE
Revision: 0

FOUNDATIONS

	Installation Verification	Comments
1	Confirm footing and top of wall elevations meet contract requirements.	
2	Confirm footings, concrete piers and walls have required reinforcement installed.	
3	Confirm proper placement and construction of concrete/ piers and walls.	
4	Confirm concrete meets quality requirements and incorporate test results.	
5	Confirm mix design for concrete	
6	Confirm bearing capacity of the material under the footing	

Installing Contractor: (Print Name)	Signature:	Date:
General Contractor: (Print Name)	Signature:	Date:
Design Consultant: (Print Name)	Signature:	Date:
TW Representative: (Print Name)	Signature:	Date:
Commissioning Authority: (Print Name)	Signature:	Date:

1 of 1

CIVIL INSTALLATION VERIFICATION

APPENDIX C

Project: PROJECT
Project #: NUMBER
Location: LOCATION
Form #: CE-I01 (DATA)
Date: DATE
Revision: 0

FOUNDATIONS

Location	Description	Footing/Wall Top Elevation [1]	Footing/Piers Reinforcement [2]	Placement [3]	Concrete Quality [4]	Mix Design [5]	Bearing capacity [6]	Comments

Appendix F - Systems Manual Template

Appendix G - Commissioning Report Template

Commissioning Report

1. Commissioning Report Intent
2. Executive Summary
   - 2.1 Observations
   - 2.2 Conclusions
   - 2.3 Outstanding items
   - 2.4 Recommendations
3. Commissioning Overview
   - 3.1 Description of commissioning process benefits
   - 3.2
4. Owner's Project Requirements
5. Basis of Design report
6. Commissioning Plan
   - 6.1 General Building Information
   - 6.2 Abbreviations and Definitions
   - 6.3 Purpose of the Commissioning Plan
   - 6.4 Commissioning team information
   - 6.5 Project Narrative
   - 6.6 Systems to be commissioned
   - 6.7 Systems Descriptions
   - 6.8 Roles and Responsibilities
   - 6.9 Commissioning Process
   - 6.10 Schedule
   - 6.11 Installation Verification checklists (construction checklist)
   - 6.12 Performance Verification checklists (test results forms and evaluation)
   - 6.13
7. Project commissioning specifications
8. Commissioning checklists
9. Release for Use Forms
10. Summary of the design review process
11. Summary of the training process
12. Summary of the submittal review process
13. Summary of the O&M documentation
    - 13.1 Operation and Maintenance Manuals
14. Maintenance Material
15. Warranties
16. Design and Construction Review
17. Value of Commissioning
18. Occupancy and operation evaluation reports
19. History of any system deficiencies identified and how they were resolved, including any outstanding issues or seasonal testing scheduled for a later date
20. Contractor plan for resolution within 10 months of substantial completion
21. Confirmation from the CxA indicating whether individual systems meet the Owner's Project Requirements, Basis of Design, and contract documents

Appendix H - 10 Month Review Survey and Plan

Building Name: _____ Date: _____

Point – In – Time Thermal Comfort Survey

1. Record the approximate outside air temperature and seasonal conditions:

___Winter ___Spring ___Summer ___Fall

_____°C ___Sunny ___Raining ___Foggy ___Windy

2. What is your general thermal sensation (check one that is most appropriate)?

___Hot ___Warm ___Slightly Warm

___Neutral

___Slightly Cool ___Cool ___Cold

3. Place an X where you are located:

Insert sketch of facility

Room Identification: _____

4. On which floor of the building are you located?

___ Basement ___1 ___2 ___3 ___4 ___5 ___6 ___7 ___8 ___9

5. Are you near an exterior wall (with in 15 ft)?

___Yes ___No

6. Using the list, please check each item of clothing that you are wearing:

___ Short-Sleeve shirt	___Long Sleeve Shirt	___T-Shirt
___ Long Sleeve Sweatshirt	___Sweater	___Vest
___ Jacket	___Knee-Length Skirt	___Ankle Length Skirt
___ Dress	___Shorts	___Athletic Sweatpants
___ Trousers	___Undershirt	___Long Underwear
___ Long Sleeve Coveralls	___Overalls	___Slip
___ Nylons	___Socks	___Boots
___ Shoes	___ Sandals	Other: _____

7. What is your activity level?

___Reclining ___Seated

___Standing Relaxed ___Light Activity Standing

___Medium Activity Standing ___High Activity

Building Name: _____ Date: _____

Satisfaction Survey

Insert sketch of facility

1. Place and X where you spend most of your time:

2. On which floor of the building are you located for normal hours?

___ Basement ___1 ___2 ___3 ___4 ___Other

3. Are you near an exterior wall (with in 15 ft)?

___Yes ___No

4. Are you near a window (with in 15 ft)?

___Yes ___No

5. Which of the following do you personally adjust or control in your space

___Windows blinds or shades
___Room air conditioning unit
___Portable heater
___Permanent heater
___Adjustable air vent
___Portable Fan
___Door to exterior space
___Adjustable floor air vent
___Operable window
___Door to interior space
___Thermostat
___Ceiling Fan
___None of these
Other _____

6. How satisfied are you with the temperature in your space?

Very satisfied 1 2 3 4 5 6 7 8 9 10 Very Dissatisfied
(Circle level of satisfaction)

7. If you are dissatisfied with the temperature in your space, which of the following contribute to your dissatisfaction? The temperature in my space is:

In warm/hot weather:

___Occasionally too hot ___Always too hot ___Often too hot

___Always too cold ___Occasionally too cold ___Often too cold

In cool/cold weather:

___Occasionally too hot ___Always too hot ___Often too hot

___Always too cold ___Occasionally too cold ___Often too cold

When is this most often a problem?

___Morning (before 11am) ___Midday (11am-2pm) ___Afternoon (2pm-5pm)

___Evening (after 5pm) ___Monday mornings ___Weekends/holidays

Other:_____ ___No particular time ___Always

8. How would you best describe the course of this discomfort?

___Humidity too high (damp)
___Air movement too high
___Incoming sun
___Drafts from windows
___My area is hotter/colder than other areas
___Thermostat is adjustable by other people
___HVAC system does not respond quickly enough
___Deficient window
___Humidity too low (dry)
___Air movement too low
___Heat from office equipment
___Drafts from vents
___Thermostat is inaccessible
___Clothing policy is not flexible
___Hot/cold surrounding surfaces

9. Describe any other issues related to being too hot or cold in your space.

-

Appendix I - Meeting Agenda and Minutes

COMMISSIONING MEETING AGENDA

{Insert Project Name}
Project Number: {Insert Project Number}

Location:
Date & Time: Start: End:

Invited Attendees:

Item Number	Item
1	Introduction
1.1	Safety
2	The Commissioning Team:
2.1	Identify main members of the commissioning team and their responsibilities.
3	The Commissioning Manual:
3.1	Verification Checklists
3.2	Release For Use Forms
3.3	Training
3.4	Operation & Maintenance
3.5	Maintenance (Extra) Material
3.6	Warranties
4	Documentation:
4.1	Discuss how the commissioning documentation will be collected and stored.
5	Commissioning Process
5.1	Schedule – itemized scheduling of Performance Verification for all systems for all disciplines. The contractor may refer to the Cx checklist index when completing the Cx schedule. Functional performance testing does not begin until Installation Verification, start-up and TAB is completed.
5.2	Meetings
5.3	Substantial Completion
5.4	Seasonal/Deferred commissioning
6	Submittals
6.1	TAB Report
6.2	Start-up Reports
6.3	3 copies of completed Cx manual for review
6.4	Report of seasonal/deferred commissioning

COMMISSIONING MEETING MINUTES

{Insert Project Name}
Project Number: {Insert Project Number}

Meeting Number:

Location:
Date & Time:

Distribution:

Those in attendance:

Name	Email

Those not in attendance:

Name	Email

Item Number	Item	Responsibility	Completion Date	Status
1	Introduction			
1.2	Safety Topic			
2	The Commissioning Team			
2.1	Member Listing and contact information			

COMMISSIONING MEETING MINUTES

{Insert Project Name}
Project Number: {Insert Project Number}

Meeting Number:

Item Number	Item	Responsibility	Completion Date	Status
3	The Commissioning Manual			
3.1	Verification Checklists			
3.2	Release For Use Forms			
3.3	Training			
3.4	Operation & Maintenance			
3.5	Maintenance (Extra) Material			
3.6	Warranties			
4	Documentation			
4.1	Documentation Procedure			
5	Commissioning Process			
5.1	Schedule Itemized scheduling of Performance Verification for all systems for all disciplines. The contractor may refer to the Cx checklist index when completing the Cx schedule. Functional performance testing does not begin until Installation Verification, start-up and TAB are completed.			

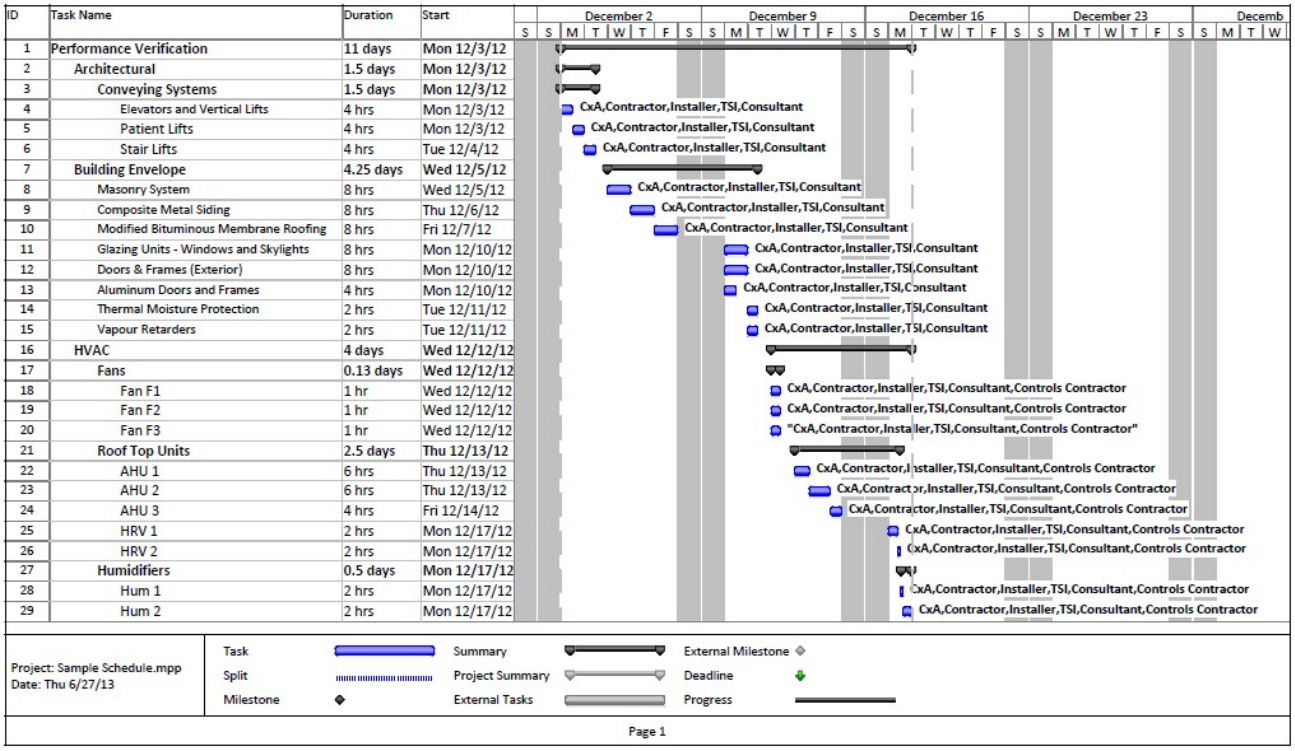
COMMISSIONING MEETING MINUTES

{Insert Project Name}
Project Number: {Insert Project Number}

Meeting Number:

Item Number	Item	Responsibility	Completion Date	Status
5.2	Meetings Frequency Schedule Chair			
5.3	Substantial Completion			
5.4	Seasonal/Deferred Commissioning			
6	Submittals			
6.1	TAB Report			
6.2	Start-up Reports			
6.3	3 copies of completed Cx manual for review			
6.4	Report of seasonal/deferred commissioning			
6.5	Next Meeting Date, Time and Location			

Appendix J - Sample Schedule



ID	Task Name	Duration	Start
1	Performance Verification	11 days	Mon 12/3/12
2	Architectural	1.5 days	Mon 12/3/12
3	Conveying Systems	1.5 days	Mon 12/3/12
4	Elevators and Vertical Lifts	4 hrs	Mon 12/3/12
5	Patient Lifts	4 hrs	Mon 12/3/12
6	Stair Lifts	4 hrs	Tue 12/4/12
7	Building Envelope	4.25 days	Wed 12/5/12
8	Masonry System	8 hrs	Wed 12/5/12
9	Composite Metal Siding	8 hrs	Thu 12/6/12
10	Modified Bituminous Membrane Roofing	8 hrs	Fri 12/7/12
11	Glazing Units - Windows and Skylights	8 hrs	Mon 12/10/12
12	Doors & Frames (Exterior)	8 hrs	Mon 12/10/12
13	Aluminum Doors and Frames	4 hrs	Mon 12/10/12
14	Thermal Moisture Protection	2 hrs	Tue 12/11/12
15	Vapour Retarders	2 hrs	Tue 12/11/12
16	HVAC	4 days	Wed 12/12/12
17	Fans	0.13 days	Wed 12/12/12
18	Fan F1	1 hr	Wed 12/12/12
19	Fan F2	1 hr	Wed 12/12/12
20	Fan F3	1 hr	Wed 12/12/12
21	Roof Top Units	2.5 days	Thu 12/13/12
22	AHU 1	6 hrs	Thu 12/13/12
23	AHU 2	6 hrs	Thu 12/13/12
24	AHU 3	4 hrs	Fri 12/14/12
25	HRV 1	2 hrs	Mon 12/17/12
26	HRV 2	2 hrs	Mon 12/17/12
27	Humidifiers	0.5 days	Mon 12/17/12
28	Hum 1	2 hrs	Mon 12/17/12
29	Hum 2	2 hrs	Mon 12/17/12

1. For illustration purposes only. Similar or deeper level of detail for all disciplines is required on schedules submitted by the contractor.

Appendix K - Commissioning Issues Log

Date	Issue	Raised By	Resolution	Close Date	Assigned to	Status