THE UNIVERSITY OF TEXAS
AT AUSTIN

Renovation Project
Master Commissioning Plan
Renovation Project
Master Commissioning Plan

Prepared for:
The University of Texas at Austin
Physical Plant
Renovation Project Delivery Enhancement Program

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PREFACE

Renovation Project Master Commissioning Plan

Introduction

A. Purpose of this Model Commissioning Plan

1. The Model Commissioning Plans and appendices that follow describe the four Levels of commissioning process for University of Texas renovation projects. This preface provides an overview and introduction to the use of these documents.

B. Graded Approach

1. There are four levels of the Commissioning Process for renovation projects at the University of Texas. Structured evaluations of project risk and complexity differentiate the four levels.
   a. Level 1 projects have high risk or high complexity.
   b. Level 2 projects are no higher than medium risk or medium complexity.
   c. Level 3 projects are no higher than low risk or low complexity.
   d. Level 4 projects have very low risk and very low complexity.

2. Level 1 applies to projects with the highest levels of risk or complexity. Consequently, the Level 1 Model Commissioning Plan is the most intensive.

3. Level 2, Level 3, and Level 4 Model Commissioning Plans are subsets of the Level 1 Model Commissioning Plan. Level 2 omits commissioning tasks from the Level 1 list. Level 3 omits or simplifies still more tasks. Level 4 is the simplest Model Commissioning Plan. Level 4 is similar to the activities already in place.

4. The Appendices contain the tools to help renovation project managers determine which level of Commissioning applies to each project. There are matrices to help determine the risk level and complexity level of a renovation project.

5. Once a renovation project manager has determined the appropriate level of Commissioning, they should refer to the Model Commissioning Plan for the selected level. The Model Commissioning Plan guides the project manager in implementing the Commissioning Process on the project.

6. The first Commissioning Process task for a new project is determination of the Commissioning Level to be applied to the project.

7. Record the commissioning level in the Project Requirements (PR) document and attach the risk and complexity evaluation matrices and the commissioning level decision tree.
To determine the appropriate commissioning level for a project, follow these steps, in this order:

1) Evaluate risk: use the “Risk Matrix” (Risk Level Evaluation Worksheet, Appendix A) to assign a risk level to the project.

2) Evaluate complexity: use the “Complexity Matrix” (Complexity Level Evaluation Worksheet, Appendix B) to assign a complexity level to the project.

3) Assign the Commissioning Level corresponding to the risk and complexity levels for the project based on the following table:

<table>
<thead>
<tr>
<th>High risk or high complexity</th>
<th>Commissioning Level 1</th>
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<td>Medium risk or medium complexity</td>
<td>Commissioning Level 2</td>
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<td>Low risk or low complexity</td>
<td>Commissioning Level 3</td>
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<tr>
<td>Very low risk and very low complexity</td>
<td>Commissioning Level 4</td>
</tr>
</tbody>
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C. Determining Commissioning Level – The Matrices

1. Risk Matrix (Appendix A)

   a. The first step in determining the appropriate level of commissioning for a project is to assess its level of risk. The Risk Matrix, Appendix A, lists some of the issues a Project Manager should consider in determining the level of risk associated with project elements. Circle the bullets for any line items that apply to the project. Assign to the project the risk level (high, medium, low or very low) of the highest risk level bullet circled. The risk evaluation worksheet contains detailed instructions.

   The list is generic, and necessarily incomplete to avoid an overwhelming catalog of possible risk elements. Commonly encountered risk elements should be added in future updates of the Model Commissioning Plan. The following comments will assist the user in assigning an appropriate risk rating to an element or system that is not listed.

   b. Assign projects to the High Risk category if they contain systems or elements for which failure would involve:

      1) Life safety risks,
      2) Chemical, biological or radiological hazards, or
      3) Organizational risks (High visibility “do or die” projects)

   c. Assign projects to the Medium Risk category if failure of any system or failure to meet schedule might result in major inconvenience or discomfort to a large group of occupants, or might impact their mission.

   d. Assign projects to the Low Risk category if failure of any system or failure to meet schedule might result in mild discomfort or inconvenience to the occupants of the space.

   e. Assign projects to the Very Low Risk category if their most challenging requirements involve providing a space for people to work or study.
2. **Complexity Matrix (Appendix B)**
   a. The second step in determining the appropriate level of commissioning is to assess the level of complexity for a project. The Complexity Matrix, Appendix B, contains some of the elements a Project Manager should consider to determine the level of complexity associated with a project. Circle the bullets for any line items that apply to the project. Select the complexity level (high, medium, low or very low) to the project of the highest complexity level bullet circled. The complexity evaluation worksheet contains detailed instructions.

   While the list appears long and detailed, it is still not fully inclusive of all possible project elements. Therefore, a few remarks may help the user apply the principles embedded in the elements that are rated in the matrix. The goal is to help the user assign complexity to other elements not rated in the matrix with reasonably consistent criteria and results.

   b. Typically, projects that involve multiple complex inter-related systems will be considered as **High Complexity**. This would include major lab renovations and similar projects.

   c. Projects that involve one or more complex systems that are not inter-related would probably fall into the **Medium Complexity** classification. A multi-media classroom or minor lab renovation might meet this criterion.

   d. If the project involves one or more simple systems (HVAC distribution, lighting, etc.) it would be considered **Low Complexity**. Major office renovations would fall into this category.

   e. Projects that involve primarily finishes and furnishings will usually be considered **Very Low Complexity**. Typical projects would be the renovation of offices.

3. **Commissioning Level Task Matrix (Appendix C)**
   a. The Commissioning Level Task Matrix, Appendix C, is an extensive list of commissioning tasks sorted by project phase. Bullets under the four Commissioning Level columns indicate which tasks apply to any given level of commissioning.

   b. Project managers should use the Commissioning Level Task Matrix as a convenient checklist to manage the Commissioning Process. It is only a guide and the specific tasks required for a particular project will be determined by the Project Manager in conjunction with the Commissioning Technician.

D. **Commissioning Plan**

   1. After determining the Commissioning Level, the Project Manager should acquire a copy of the corresponding Model Commissioning Plan. Each Commissioning Level has a unique Model Commissioning Plan, but the plans are generic. Add the specifics for each project and edit the Model Commissioning Plan to create the Project Commissioning Plan.

   2. Model Commissioning Plans contain **hidden text in blue font**. Hidden text provides guidance to the Project Manager, and is not needed by the rest of the project team. The hidden text should be turned off when the Project Commissioning Plan is printed or distributed electronically.
3. The Project Commissioning Plan guides the Project Manager through the first few commissioning tasks leading up to the acquisition of the Commissioning Authority. Once the Commissioning Authority is on board, the Project Manager gains expertise and assistance in achieving quality performance.

E. Schedule

1. The Start of the Commissioning Process
   a. To gain the greatest benefit at the lowest cost, initiate the Commissioning Process as soon as the renovation project starts, during the Predesign Phase. Lose no time in determining the Commissioning Level and establishing the Commissioning Team membership, including the Commissioning Authority.

2. Impact of the Commissioning Process on the Project Schedule
   a. When the Commissioning Process starts timely and is properly managed, it has negligible impact on the overall project schedule.
   b. During the Design Phase, updating and review of documents and other commissioning activities take place concurrently with other activities for the most part.

There are two possible Design Phase exceptions.

1) The first is creating the Basis of Design document, a task normally allotted to the design team. Designers want to reserve additional time for this work. In practice, however, we find that the design team actually benefits from the increased clarity and focus that results from the effort to formalize a heretofore unstructured, poorly documented set of assumptions.

2) The second is the coordination of the commissioning specification with other specification provisions. Typically, this requires one short meeting during Design Development to agree on how to handle various requirements that overlap traditional testing and commissioning testing. Commissioning Team members discuss whether to specify a particular test in Division 15, where it has been in the past, or in the commissioning specification, where it can be managed under the umbrella of the Commissioning Process. Typically, the Commissioning Team decides to put the technical requirements in one place and reference it in the other.

   c. During Construction, all commissioning activities occur concurrently with other construction activities, with limited exceptions. Intersystem tests, and possibly some system tests, require that all systems be complete and fully functional. If it were not for commissioning, the point at which all work is complete and fully functional would be considered Substantial Completion. Instead, the contractor may need one to several days to perform these last commissioning tests after the rest of the work is complete.

3. Late Start of the Commissioning Process
   a. What about a project that misses the timely start of the Commissioning Process? Experience shows that the Commissioning Process can be started after Predesign, but that it requires more effort and can have a greater impact on schedule than if it commenced timely. If the Commissioning Process starts late, the commissioning activities that normally would have been completed before
that point in the project must be done immediately in order to catch up to where
the Process should have been.

The difficulty with the late start is that decisions about Project Requirements
criteria must be revisited. In some cases, the Commissioning Team may
conclude that the project needs to be refocused to achieve some of the PR
criteria. In other words, reworked at additional cost and time.

b. If the Commissioning Process starts late in the Design Phase, there may not be
time to catch up with missed commissioning activities before the project goes to
bid. The two greatest liabilities in this scenario are, in addition to the lack of PR
documentation, lack of effective design review and poorly assembled or missing
commissioning specifications.

Ineffective design review results in higher numbers of RFI’s and change orders.

Poor or missing commissioning specifications makes inclusion of the contractor
in the commissioning process difficult and/or expensive.

F. Team Philosophy

1. Quality Assurance or Forensics?

a. The team approach to the Commissioning Process is a quality assurance approach
that proactively minimizes failures. It does this by encouraging each project
participant to control the quality of their own work, and by evaluating the
effectiveness of that quality control effort. The Commissioning Process sets clear
expectations for each entity’s work and communicates those expectations clearly.
The Commissioning Process establishes accountability for quality control by each
entity.

b. Without the team approach, we are left with forensic commissioning to identify and
diagnose what went wrong. Forensic commissioning adds one new player, the
Commissioning Authority, to the owner’s resources to help ferret out and assign
blame for failures that occurred. There is little opportunity to prevent failures.

c. The University of Texas at Austin adopted the proactive team approach to the
Commissioning Process. Every member of the project team, from UT staff, to
design consultants, to suppliers and contractors, plays a vital role in delivering
quality, high performance renovation projects.

G. Scope of Commissioning

1. Elements of Scope

In order to define the scope of commissioning for a project, we must consider two

a. Systems and Equipment

To define the scope of the commissioning process for a project, first determine
which equipment and systems should be included.

b. Functions and Characteristics

Once we establish a list of equipment and systems, then we can determine which
functions or characteristics are important for each of the items on the list. These
functions and characteristics are the starting points for defining the acceptance
criteria. Some equipment, a variable volume fume hood for example, warrants extensive verification procedures. Other items normally justify only a simple check, to verify that the new light fixtures in a room turn on and off in response to the switch, for example.

Most items, however, are less easily categorized. For such indeterminate items, the Commissioning Team draws on their experience to evaluate which characteristics and functions to include in the scope. An example of this might be a new variable air volume terminal unit. If it is in the dean’s office, we might decide to be more rigorous than if it were in a student lounge area.

c. Therefore, if we need to adjust the scope of commissioning to respond to budget or schedule constraints, we have two elements that we can adjust. Deleting a system or piece of equipment deletes all commissioning work that would be associated with that item. This is a somewhat wholesale scope reduction. On the other hand, we can exercise discretion in defining the functions or characteristics of a particular item to fine-tune the scope when we are not comfortable with wholesale deletion.

2. Who decides?
   a. The Commissioning Team Recommends
      Numerous Commissioning Team members have opinions about what should be included in the scope of commissioning, for reasons that vary from painful personal experience to strong beliefs in the environmental benefits. The list of “candidate” equipment and systems should be inclusive.
   b. The Project Manager has the Final Call
      Ultimately, however, the project manager will make a decision based on limited budget and perceived priorities, guided by the advice of the Commissioning Authority.

3. Matrix Concept
   a. In approaching the problem of deciding how to reconcile the limited budget with the endless list of candidate equipment and systems, it may be helpful to think of a matrix of commissioning activities versus candidate equipment and systems. A matrix similar to the Commissioning Team Responsibilities in Appendix (_)_ can be modified to list the various candidate equipment and systems across the top, with the same list of commissioning activities on the side.
   b. There would conceivably be two ways to reduce the scope of commissioning to match the budget. One could either cut the number of commissioning activities for all systems and equipment. Alternatively, one could cut equipment and systems from all commissioning activities.
   c. The graded approach to commissioning adopted by UT has already established a rational approach to reducing the number of commissioning activities for all equipment and systems. Further modifications of the scope of commissioning activities risks undermining the integrity of the Commissioning Process.
   d. Instead, when Project Managers need to reduce the scope of commissioning, they should prioritize the candidate equipment and systems and make reductions by eliminating some equipment and systems from the entire Commissioning Process.

4. Scope of Commissioning
   Two primary elements of the scope of commissioning are the list of equipment and
systems, and the list of functions and features associated with each piece of equipment of system.

a. How to Prioritize Equipment and Systems
   In order to reduce the scope of commissioning, rank the equipment and systems in order of relative importance for commissioning. Using a scale of 1 to 5 in which 5 is the highest priority, rate each piece of equipment and system according to the factors below. Delete lowest scoring equipment and systems from the scope of commissioning. Factors to consider include:
   
   1) Risk  
   2) Complexity  
   3) Mission-criticality  
   4) Environmental impact (energy, pollution, resource depletion)   
   5) Political impact

b. How to Prioritize Functions and Features
   For each piece of equipment or system included in the scope of commissioning, determine which functions and features should be evaluated by the Commissioning Process. For example, the brightness of an LCD readout screen on a chiller in a dimly lit mechanical room may be far less critical than a similar LCD readout screen exposed to the full sun on a rooftop unit. Prioritization of functions and features may also help in reducing the scope of commissioning when the budget is tight. Delete the lowest priority functions and features from the lowest rated systems and equipment in order to reduce the cost of commissioning.

H. Tracking the Benefits of the Commissioning Process – Metrics

1. The benefits of investing in the commissioning process are well documented. Most organizations’ investment criteria embrace the simple payback economics. The cost of the commissioning investment is typically recouped in less than two years, and may actually reduce first costs during the construction phase of a project to such an extent that payback is immediate. (The Cost-Effectiveness of Commercial-Buildings Commissioning, E. Mills et. al., 2004, LBNL).

2. However, most organizations also want to quantify the return in their particular investment in commissioning. This will be true at the University of Texas as the commissioning process is applied to renovation projects.

3. It is important, therefore, to document the costs and benefits of investing in the commissioning process. The following are suggestions of measurements that should be recorded and analyzed. Other metrics may become apparent with experience.

   a. Avoided Costs: When the commissioning process identifies and corrects issues, measurable, or at least reasonably estimable, benefits may result. An effort should be made to estimate the avoided costs at the time the Issue Report Form is filled out. Avoided costs include utility consumption and demand charges, premature equipment failure, and lost productivity, among others.

   b. Service Calls: A special case of avoided costs is the reduction in the number of service calls after completion of construction. The value of this measure is appreciated by comparing the average number of service calls associated with projects that were not commissioned with commissioned projects. It may be appropriate to differentiate the types of projects or the types of facilities.
Commissioned highly complex or technical projects may have more calls than simple projects.

c. Change Orders and Requests for Information: Higher quality bid documents result from the commissioning process activities in the predesign and design phases. Higher quality bid documents generate fewer requests for information and change orders. Track RFIs and change orders and their estimated costs, to compare with uncommissioned project history. Many organizations find the reduction in RFIs and change orders equals or exceeds the investment in the commissioning process.
MODEL COMMISSIONING PLAN – LEVEL 1

Renovation Project Master Commissioning Plan

Note: This document contains “hidden text,” which should be displayed in BLUE. If you do not see blue text in this document, it can be turned on in MS Word by pulling down the Tools menu and selecting Options. In the Options window, select the View tab. Under Nonprinting characters, select the Hidden text option. Then click OK.

Hidden text is set NOT to print. However, if it does print, go to the Tools/Options window. On the Print tab under Include with document, turn off the Hidden text selection.
Introduction

A. Purpose of this Model Commissioning Plan

1. This Commissioning Plan describes the Level 1 commissioning process for [project name]. It describes the organization, responsibilities, and documentation of the Commissioning Process.

   - This “Model” Commissioning Plan for the Level 1 commissioning process is the framework for development of the “Project” Commissioning Plan. By turning off viewing of the hidden text in this document, and replacing bracketed fields […] with project-specific information, the remaining text is the first draft of the “Project” Commissioning Plan.

   - The “Model” Commissioning Plan describes the elements of the Commissioning Process in general terms applicable to projects assigned a Level 1 Commissioning Process status, without regard to the requirements of any specific project. The “Project” Commissioning Plan describes those project-specific requirements.

2. This Commissioning Plan is a communication and planning tool. It is not a contract document. Responsibilities described must be incorporated in the contracts with the various Commissioning Team members.

B. Scope

1. The Commissioning Plan describes the following elements of the Commissioning Process:

   - Commissioning Process from predesign through occupancy,
   - Commissioning team responsibilities during each phase of the project,
   - Scope of the commissioning process in terms of the equipment and systems to which the process applies, and in terms of the types of functions and features of interest for the included equipment and systems, and
   - Documentation requirements in each phase of the project.

Use of the Model Commissioning Plan

- This Level 1 Model Commissioning Plan is part of a graded approach to the commissioning of renovation projects. It applies to projects assigned to the Level 1 Commissioning Process.

- This is a “Model” Commissioning Plan for renovation projects. It is a template that outlines a generic Level 1 Commissioning Process. Use this Model Commissioning Plan
to generate project-specific Commissioning Plans for projects assigned to the Level 1 Commissioning Process.

- Use the companion “Model” Commissioning Plans for Level 2, Level 3 and Level 4 Commissioning Process projects.
- This “Model” Commissioning Plan should be reviewed and updated periodically as UT gains experience with the application of the Commissioning Process to renovation projects.
- This “Model” Commissioning Plan is not intended for application to Capital Projects, which are larger, proceed at a different pace, and command more resources.

**Background**

- Physical Plant decided to apply the commissioning process to improve the quality of renovation projects as an element of the Renovation Project Delivery Enhancement Program (RPDEP). The Process Action Team (F-PAT) charged with developing Theme #6, Institutional Stewardship and Commissioning, developed this Model Commissioning Plan with the support of Casault Engineering.

**C. Objectives of the Commissioning Process**

- Clearly document Project Requirements.
- Improve delivery of renovation projects.
- Improve maintainability and service life.
- Optimize resource consumption.
- Minimize negative impacts on the campus, surrounding buildings, and existing systems.

**D. Definition of Commissioning Process**

1. A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its system and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s Project Requirements. (ASHRAE Guideline 0-2005)

**II QUALITY PHILOSOPHY**

**A. Quality Control**

1. The Commissioning Process, at all Levels, holds the owner, operator/maintainer, designer, contractor, manufacturer and installer fully accountable for the quality of their work. Each of these commissioning team members must manage and control the quality of their work continuously. Only the people doing the work can create quality.

**B. Quality Assurance**

1. The Commissioning Process evaluates the effectiveness of the management and control of quality by the people doing the work.
2. The Commissioning Process is not a substitute for quality control. Diligently resist attempts to subvert the quality assurance function of the Commissioning Process into a substitute for quality control. Any such tendency increases the cost of the Commissioning Process and reduces its effectiveness. When the people doing the work are not held accountable for the quality of their work, quality declines markedly.

3. When design firms working for a major university figured out that the university engineers’ reviews were extensive, the designers became lax in checking the quality of the work before submitting it for review. They knew that the university staff would identify their errors for them.

III  **COMMISSIONING PROCESS**

A. **Commissioning Activities by Phase**

1. This section of the Model Commissioning Plan is a description of commissioning tasks specific to the Level 1 Commissioning Process for this project. The Commissioning Team section of this Model Commissioning Plan describes the responsibilities for each of these tasks. Tasks are listed in approximately sequential order, with earliest tasks listed first.

2. **Predesign Phase**

   **PP-1. Determine Commissioning Level:** To determine the appropriate commissioning level for a project, follow these three steps, in this order:
   
   (1) Evaluate risk as described in the Preface.
   
   (2) Evaluate complexity as described in the Preface.
   
   (3) Select the commissioning level based on the table below. Select the Commissioning Level corresponding to the highest rated factor. A medium risk/low complexity project would be Level 2, for example.

   | High risk or high complexity | Commissioning Level 1 |
---|---|
| Medium risk or medium complexity | Commissioning Level 2 |
| Low risk or low complexity | Commissioning Level 3 |
| Very low risk and very low complexity | Commissioning Level 4 |

See the Preface for a discussion of determining the appropriate Commissioning Level for a project.

The Commissioning Level for this Project is **Level 1**. If this project is not Level 1, then use the Model Commissioning Plan that corresponds to whichever Level is determined.

The Commissioning Level determination is based on the following factors:
Risk: [High] [Medium] [Low] [Very Low]. Select the risk level for this
Complexity: [High] [Medium] [Low] [Very Low]. Select the complexity level for this project. Delete other levels.

Record the Commissioning Level in the PR document and attach the Risk Evaluation Matrix and the Complexity Evaluation Matrix to this Commissioning Plan.

PP-2. Adapt Model Commissioning Plan: When the Commissioning Level has been assigned, use the corresponding Model Commissioning Plan as a guide to the commissioning process. Save a copy of the Model Commissioning Plan as the new [Project] <project name> Commissioning Plan. Edit the [Project] Commissioning Plan to reflect the specifics of the project to the extent possible at this point in the project. The edited document is the first draft of the [Project] Commissioning Plan.

PP-3. Define Scope of Commissioning: To the extent possible, define the scope of commissioning. There are two elements of the scope of commissioning. The first is a list of equipment and systems anticipated to be included in the project that should be commissioned. The second element is a list of functions or features of the selected equipment or systems that should be commissioned. At this point in the project, the list of equipment and systems can probably be anticipated with reasonable confidence. However, the functions and features element is probably best left until the Commissioning Authority is on board and the design develops. Use this information to edit the “Scope of Commissioning” section of the [Project] Commissioning Plan.

PP-4. Define Commissioning Team: Edit the Team Membership paragraph under the “Commissioning Team” section of the Model Commissioning Plan to reflect the actual organizations and individuals who will participate on the Commissioning Team. Some information may not be available until later.

Determining who will provide the services of the Commissioning Authority is a particularly urgent decision. The Commissioning Authority may be either an in-house resource or contracted PSP.

PP-5. Secure Commissioning Authority: Immediately after determining how the services of the Commissioning Authority will be acquired, initiate the process of getting them involved in the project. If an in-house resource is appropriate, notify the organization or individual promptly. If a contracted resource is needed, work with Business Services to expedite the selection and procurement of the commissioning professional. Delay of the procurement of the Commissioning Authority results in lost opportunities and higher commissioning costs.

PP-6. Record and Track Issues: As issues are identified, record them and track their status until each is satisfactorily resolved. Appendix F contains a Commissioning Issue Report Form.
PP-7. Define Project Requirements (PR) Issues: Convene a meeting/workshop of all stakeholders to identify which issues to include in the PR document. Make sure input is effectively elicited from all stakeholders. Record all issues in the PR document. To the extent possible get input on performance criteria also. See the discussion of the PR document under the “Documentation” section.

Note: Incorporate development of the PR issues and the associated performance criteria with project programming. Project Requirements are essential elements of the project program.

Workshop Format: The facilitator (typically the Commissioning Authority) elicits input from all project stakeholders. The following format has proven effective:

1. Present open-ended questions, or broad concepts, to the group. Questions should be sufficiently broad and open-ended to elicit a wide range of responses. All discussions and comments are treated as confidential, and are not to be repeated outside of the workshop.

2. For each subject or question, ask each participant to take three to five minutes to write down as many responses as they can.

3. Record individual responses in a round-robin session, asking each person in turn to share one of their responses. Do not allow discussion at this point, except as necessary for the facilitator to be able to record the response accurately. Record responses on something that all can read (flip charts, erasable boards, PC projector, etc.).

4. Review and clarify all responses, so everyone has a common understanding of each response. Combine similar responses.

5. Ask participants to rank the responses on a scale of 1 to 5.

6. Determine a group ranking based on the combined individual responses. Discuss the top ten or so responses to further clarify and gain any additional insight. As a group, decide how many of the responses should become project requirements. The top-ranked responses from each subject become the project requirements.

PP-8. Prompt for PR Performance Criteria: Beginning with the effort to define the PR issues, prompt stakeholders for performance criteria for each PR issue. Additional meetings and correspondence may be needed to complete the criteria. Some performance criteria require input from design specialists who are not yet involved in the project. Record performance criteria in the PR document.

Note: The facilitator of the workshop should encourage participants to focus on defining the issues clearly and establishing measurable acceptance criteria. Avoid the tendency to drift into problem-solving discussions. Problem-solving is the design professional’s responsibility.

PP-9. Review Lessons Learned: Apply the principles of continuous improvement to the Commissioning Process. Start by reviewing lessons learned on other projects. Use the results to improve the PR document and criteria, and the
Project and Model Commissioning Plans. Record changes required for this project in the PR document.

**PP-10. Establish Commissioning Budget:** Past experience with similar projects is the best basis for estimating the commissioning budget. When suitable project experience is not available, use rules of thumb to estimate the commissioning budget, and solicit input from the Commissioning Authority. Record the commissioning budget in the PR document.

**PP-11. Determine Commissioning Schedule Expectations:** Include schedule expectations in the PR document. During Predesign, it is sufficient to state whether there is any reason to believe that the Commissioning Process may add any time either to the Design or Construction Phase schedule. Normally, the Commissioning Process should add no time to the schedule except perhaps a couple of days for final intersystem tests after the last finishes are complete. Record the commissioning schedule expectations in the PR document.

**PP-12. Initiate Systems Manual:** Establish the table of contents during Predesign and add documentation generated during this phase. Set up the Systems Manual to allow for easy addition of new materials as they become available in later phases.

**PP-13. Review Predesign Documents:** Before closing the Predesign phase, review the PR document for completeness and clarity of performance criteria. Review other documents created during Predesign to verify conformance with the PR document. Other documents include the Project Commissioning Plan, and commissioning-related scope of work statements included in the contracts for the Commissioning Authority and designers.

**PP-14. Write Predesign Commissioning Report:** At the conclusion of the Predesign phase, a brief commissioning report summarizes the commissioning activities and issues. If all issues have been satisfactorily resolved, the report recommends acceptance of the Predesign phase work.

**PP-15. Accept Predesign:** If the Predesign Commissioning Report recommends accepting the Predesign phase work, and if all other Predesign activities have been completed satisfactorily, the Predesign Phase work should be accepted, with authorization to proceed to Design Phase work.

### 3. Design Phase

The Design Phase commences with the design team’s receipt of the notice to proceed and ends with the issuance of bidding documents.

For the purpose of Model Commissioning Plan, the Design Phase consists of three sub-phases: Schematic Design (SD), Design Development (DD), and Contract Documents (CD). In some projects, these sub-phases may blur or combine, depending on project management needs. Adjust the terminology in this section accordingly.

**DP-1. Validate Proposed PR Changes:** Changes to Project Requirements made after the Predesign Phase pose a high risk to the success of the project. Late PR changes typically do not receive the same attention and are not subject to the
same series of checks as those made during Predesign. The subtle ramifications of seemingly innocent PR changes are easy to overlook. Therefore, it is important to review carefully any proposed PR changes for their impact on the operation of the facility or systems. PR changes should be approved by all stakeholders before being incorporated into the PR Document.

DP-2. Update PR Document: While the goal is to fully define and document Project Requirements during the Predesign Phase, changes may be necessary as the project progresses. When Project Requirements change or are defined further, update the PR Document. Review the PR Document for necessary changes at the beginning and at the end of the Design Phase. Track changes to the PR Document using standard word processing software tracking tools. Insert notes to explain why changes were made.

DP-3. Update Commissioning Plan: Update the Project Commissioning Plan (this document) to reflect changes to the Commissioning Level, scope of commissioning, and Commissioning Team membership. As noted in the Predesign Phase discussion of the scope of commissioning, systems and equipment may need updating, but functions and features will almost certainly need updating during the Design Phase.

DP-4. Record and Track Issues: Record issues when they are identified. Track their status until each is satisfactorily resolved. Appendix G contains a Commissioning Issue Tracking Log.

DP-5. Write Basis of Design: The Basis of Design is a stand-alone document that records the concepts, calculations, decisions, and product selections used to meet the Project Requirements. It should be prepared during the Schematic Design sub-phase, and then updated when other information is available, or at design review milestones, minimum.

DP-6. Review Basis of Design: Review the Basis of Design document to verify that the solutions described will meet the Project Requirements. Review the Basis of Design at each Design Review milestone.

DP-7. SD Design Review: Review design document submittals at the conclusion of the SD phase. Record review comments on Review Comment Resolution Forms. See Appendix H for a Design Review Comment Resolution Form.

Resolve review comments before proceeding with the next sub-phase of design.

Design review starts with comparing the design submittal with the schedule of deliverables. See Appendix E for a sample schedule of Design Deliverables by Phase. If the submittal is incomplete, return it to the designer without further review.

If the submittal appears to be complete, then proceed to a review with four tasks using statistical sampling methods to review for:

1. Legibility and consistency,
(2) Coordination between disciplines,
(3) Discipline-specific review for achieving the Project Requirements, and
(4) Specification applicability and consistency with Project Requirements and Basis of Design.

DP-8. **DD Design Review:** Conduct a design review at the end of the DD phase as described in DP-7 above.

DP-9. **CD Design Review:** Conduct a design review at the end of the CD phase as described in DP-7 above.

DP-10. **Update Systems Manual:** Add new materials to the Manual as they become available.

DP-11. **Validate Systems Manual:** Review the contents of the Systems Manual to verify that the contents meet the Project Requirements regarding level of completion and quality of work.

DP-12. **Write Commissioning Specifications:** The commissioning specifications convey the contractor’s responsibilities for work in support of the Commissioning Process. See the discussion of the specifications under the Documentation section.

Develop outline-level commissioning specifications during the Design Development sub-phase. The purpose of the outline commissioning specification is to promote coordination with other sections of the specification to avoid redundancy and omissions. Outline specifications list the systems and equipment that will be tested, and to the extent possible, the functions to be tested for each.

Complete the bid commissioning specifications early in the Contract Documents sub-phase. When complete, commissioning specifications define administrative requirements for commissioning as well as the technical requirements. Technical requirements include draft construction checklists and draft commissioning test procedures and data forms.

**DP-13. Write Draft Construction Checklists:** Draft construction checklists are a component of the bid commissioning specifications. Construction checklists identify quality of work expectations for use by the contractor in their quality control program. The checklists developed during Design are draft procedures that must be updated during Construction to reflect the approved equipment-specific requirements. See the discussion of the construction checklists under the Documentation section.

**DP-14. Write Draft Commissioning Tests:** Draft commissioning test procedures and data forms identify the prerequisites, participants, test equipment, test setup, step-by-step test instructions and forms to record test data. Commissioning test procedures and data forms developed during Design are draft procedures that
must be updated during Construction to reflect the approved equipment-specific requirements. See the discussion of the commissioning test procedures and data forms under the Documentation section.

**DP-15. Define Training Requirements:** Operations and maintenance staff and occupants/users may need training. General training requirements should be addressed in the Project Requirements document. However, it is still necessary to define the specific requirements for each system. To the extent that the contractor is responsible for training, the training requirements should be called out in the bid documents. Training by the design professional may also be appropriate. If so, training services should be included in the design professional’s agreement with the owner.

Include maintenance and operations staff and occupants in training as appropriate. The training program reflects the specific needs of the trainees. Occupant training for an office building would be far simpler than for a laboratory facility with variable air volume fume hood controls. Operators who have worked with a particular control vendor’s product for many years need less training than operators who will encounter a system for the first time.

**DP-16. Write Design Phase Commissioning Report:** At the conclusion of the Design phase, a brief commissioning report summarizes commissioning activities and issues. If all issues have been satisfactorily resolved, the report recommends acceptance of the Design phase work.

**DP-17. Design Phase Document Acceptance:** If the Design Commissioning Report recommends accepting the Design phase work, and if all other Design activities have been completed satisfactorily, the Design phase work should be accepted, with authorization to issue bid documents.

4. **Bid / Acquisition Phase**

**BP-1. Discuss Commissioning Requirements at Pre-bid Meeting:** If the project is being bid, inform bidders of the commissioning requirements. Many bidders have no experience with a formal commissioning process, and those that do may have experienced very different approaches. It is to everyone’s advantage to ensure that bidders are fully informed of their commissioning responsibilities.

**BP-2. Respond to Bidder Queries re Commissioning:** If questions about the commissioning specification arise during the bid period, respond promptly.

5. **Construction Phase**

**CP-1. Validate Proposed PR Changes:** Changes to Project Requirements made after the Predesign Phase pose a high risk to the success of the project. Late PR changes typically do not receive the same attention and are not subject to the same series of checks as those made during Predesign. The subtle ramifications of seemingly innocent PR changes are easy to overlook. Therefore, it is important to review carefully any proposed PR changes for their impact on the operation of the facility or systems. PR changes should be approved by all stakeholders before being incorporated into the PR Document.
CP-2. **Update PR Document:** While the goal is to fully define and document Project Requirements during the Predesign Phase, changes may be necessary as the project progresses. When Project Requirements change or are defined further, update the PR Document. Review the PR Document for necessary changes at the beginning of the Construction Phase to reflect late Design Phase changes or addenda during the Bid period. Track changes to the PR Document using standard word processing software tracking tools. Insert notes to explain why changes were made.

CP-3. **Update Basis of Design:** Late changes to the PR document and bid period changes will likely generate changes to the Basis of Design. Fully document Basis of Design changes. Track changes to the Basis of Design document using standard word processing software tracking tools. Insert notes to explain why changes were made.

CP-4. **Validate Updated Basis of Design:** Review changes to the Basis of Design document as they occur to verify that changes are consistent with PR.

CP-5. **Update Commissioning Plan:** Revise the Commissioning Plan at the start of the Construction Phase. The revisions include addition of new Commissioning Team members, inclusion of the construction phase commissioning schedule as integrated with the master construction schedule, and specific communication and document handling protocols. Distribute the revised Commissioning Plan to all Commissioning Team members.

CP-6. **Update Systems Manual:** Add new materials to the Manual as they become available.

CP-7. **Verify Updated Systems Manual:** Review the contents of the Systems Manual to verify that the contents meet the Project Requirements regarding level of completion and quality of work.

CP-8. **Coordinate UT Staff Involvement in Commissioning:** Depending on how the commissioning duties are assigned for the project, UT staff will have varying levels of involvement, from attending training to witnessing tests. Establish clear lines of communication to ensure prompt notification of scheduled activities that require UT staff involvement.

CP-9. **Update Commissioning Team Membership:** Identify specific organizations and the individuals within those organizations who participate in the Commissioning Process. Establish and distribute to all Commissioning Team members a Commissioning Team roster with full contact information. Update and redistribute the roster when changes occur.

CP-10. **Conduct Pre-construction Commissioning Meeting:** Early in the Construction Phase, conduct a pre-construction meeting with the Commissioning Team. Distribute copies of the PR and Basis of Design documents, and review the contents. Review commissioning specification provisions. Establish and document communication and document handling protocols.
CP-11. **Commissioning Review of Submittals:** Use statistical sampling methods to review the following submittals concurrently with the owner and designer review. Focus the review on the quality of the submittals and their ability to achieve the PR’s. Pay particular attention to substitutions and proposed deviations from the contract documents that could adversely affect performance or compliance with the PR’s.

1. Shop Drawings:
2. Product Data:
3. Preliminary Systems Manual:
4. Training Program & Trainers:

**CP-12. Schedule Commissioning Activities:** Create an overall commissioning process schedule for all Construction Phase commissioning activities. Establish a logical progression of activities. Identify precedent and dependent events related to Commissioning Process activities. Determine the duration of each activity.

Once the sequence and duration of commissioning activities are established, integrate the commissioning activities into the overall construction schedule. In some cases the commissioning schedule or the construction schedule, or both need to be adjusted to make them fit together. Establish new precedents and dependencies between the commissioning and construction activities. Update the integrated schedule monthly, or as normally required for the construction schedule.

**CP-13. Update Commissioning Schedule Weekly:** When commissioning testing begins, create two-week look-ahead schedules of commissioning and precedent activities. Update the two-week look-ahead schedules weekly.

**CP-14. Finalize Commissioning Checklists:** Revise Commissioning Checklists to reflect reviewer comments and manufacturers’ recommendations in O&M manuals and installation and startup instructions.

**CP-15. Finalize Commissioning Test Procedures and Data Forms:** Revise Commissioning Test Procedures and Data Forms for the following tests to reflect reviewer comments and manufacturers’ recommendations in O&M manuals and installation and startup instructions. Mark the revised test procedures and data forms “Approved.”

1. Static tests:
2. Component tests:
3. Equipment/Assembly tests:
4. System tests:
5. Intersystem tests:

**CP-16. Periodic Commissioning Meetings:** Regularly scheduled Commissioning Team meetings are vital to maintain the progress of the Commissioning Process.
Meetings may be scheduled in conjunction with construction progress meetings. On projects with construction periods less than four months, conduct Commissioning Meetings weekly. On longer projects, conduct monthly Commissioning Meetings before the start of testing, and then switch to weekly meetings.

**CP-17. Periodic Site Visits:** Site visits evaluate the compliance of the installation with the PR document. Verify a sample of the installed work using the completed Commissioning Checklists. Proactive attention to consistent or systemic issues improves the quality of completed work and work that has not yet been completed. Observation of inconsistent issues (one or two occurrences of the same issue) improves the quality of completed work. Provide a site visit report that includes itemization of issues noted. Also, enter the issues on the Issues Log.

**CP-18. Fill Out Commissioning Checklists:** As work progresses, fill out Commissioning Checklists. The purpose is to focus the individual’s attention on quality issues that affect achievement of the PR’s. It is therefore important that the people that are doing the work have copies of the Checklists in the in possession while they work.

**CP-19. Verify Commissioning Checklists:** Verify the completed Commissioning Checklists during periodic site visits. Discrepancies between the completed Checklists and observations indicate a failure of the quality control process that should be addressed.

**CP-20. Execute Commissioning Tests:** Use the Approved Commissioning Test Procedures and Data Forms to execute the tests. The Approved procedures are detailed instructions that must be followed precisely. Field modifications must receive approval before being used. Approved modifications must be clearly recorded on the procedures and data forms.

Record test results on the Data Forms immediately when they are observed to avoid errors. Record results, sign, and date the forms legibly in black ink. Preserve the original copies of the signed Data Forms as the primary record of the tests.

Stop the test if results do not meet specified acceptance criteria. Record the failure on the Data Form. Create a Commissioning Issue Report to initiate corrective action. When the Commissioning Issue Report is returned indicating that corrective action has been completed, repeat the test in its entirety, using a new Data Form.

For any system, execute tests starting with the simplest and progress to more complex tests in the following order:

1. Static tests
2. Component tests
(3) Equipment/Assembly tests

(4) System tests

(5) Intersystem tests

**CP-21. Verify Test Data Reports:** Review test Data Forms for completeness, consistency, and compliance of reported results with specified acceptance criteria or other PR’s. Investigate results that are not acceptable, paying particular attention to patterns that indicate systemic problems. Specifications may require increasing the size of the validation sample of tests if the number of failures exceeds some limit.

**CP-22. Witness/Validate Commissioning Tests:** Use statistical methods to select a sample of completed tests to validate. The test technician repeats selected tests in the presence of a witness to demonstrate that the reported results are valid.

Witnesses must pay close attention to verify that the tests are conducted in strict accordance with the Approved Test Procedures. The witnesses must also directly observe the results of the tests to verify that the results recorded are accurate. The test technician and the witness sign and date the Data Form to validate the reported results.

Stop the test if results do not meet specified acceptance criteria. Record the failure on the Data Form. Create a Commissioning Issue Report to initiate corrective action. When the Commissioning Issue Report is returned indicating that corrective action has been completed, repeat the test in its entirety, using a new Data Form. Specifications may require validating a larger sample of tests if the number of failures exceeds some limit.

**CP-23. Verify Training:** Verify training effectiveness of operations and maintenance staff and of occupants/users by two methods. First, a witness should attend at least some of the training sessions to evaluate the effectiveness of training presentations. Second, test or interview trainees within a few weeks after the training sessions to evaluate their fundamental understanding of the systems and their ability to find specific information needed for the maintenance and operation of the systems. Occupant/user training evaluation focuses on fundamental understanding of expectations for system performance and on how occupant/user actions affect the operation of the systems.

**CP-24. Issues:** Identify, Track, Resolve: Commissioning issues result from document reviews, checklists and tests. Record each issue using the Commissioning Issue Report Form or Submittal Review Comment Resolution Form (See Appendix F). Provide as much pertinent information as possible when completing the forms.

Track issue resolution using the Commissioning Issue Tracking Log (See Appendix G). Indicate receipt of satisfactory response to each issue when the respondents complete the Report or Comment Resolution forms. Indicate
closure of the issue when resubmittals, observation, or retests indicate acceptable corrective action.

**CP-25. Commissioning Progress Reports:** Establish a reasonable schedule for commissioning progress reports. For short duration projects, weekly may be appropriate. For longer projects monthly before testing begins, and then weekly may be appropriate.

**CP-26. Incorporate New Equipment into O&M Program:** Set up a formal procedure to enter new equipment information into the O&M database. Verify the completeness and accuracy of the entered information using statistical sampling.

**CP-27. Construction Acceptance:** When the contractor applies for the certificate of functional completion, review the status of submittals, commissioning tests and outstanding issues. If all of the following conditions have been met, then issue the Certificate of Functional Completion. The Certificate of Functional Completion is a prerequisite to Substantial Completion. Therefore, action on the contractor’s application must be timely.

1. Submittals, including test Data Forms; complete and accepted,
2. Tests, including retests; complete and documented,
3. Issues; closed, and
4. All other contractor commissioning requirements except deferred tests; complete.

**CP-28. Construction Phase Commissioning Summary Report:** Following issuance of the Certificate of Functional Completion, prepare the Construction Phase Commissioning Summary Report. The report describes the commissioning process, summarizes the functional condition of the systems based on results of the tests, and documents any PR’s that were not achieved.

6. **Occupancy and Operations**

**OC-1. Submit Project to Warranty Team:** Follow the University’s project warranty turnover procedure and submit the project to the warranty team.

**OC-2. Deferred Testing:** Deferred tests are tests that could not be performed during the construction phase for reasons beyond the contractor’s control.

Deferred tests should be clearly identified in the specifications when it is reasonable to be able to anticipate the need for deferral. The contractor should request deferred test status on other tests that were not identified as such in the specification.

Because deferred tests occur after the contractor turns the systems over to UT, the roles of the Commissioning Team members will be different than for construction phase tests. Typically, UT staff will operate the systems for deferred tests instead of the contractor. Contractors and designers should be invited to attend, but are not mandatory.
Tests may be deferred for several reasons:

1. Lack of design conditions after the systems were installed (air conditioner installed in January),
2. Lack of occupancy conditions (lack of plug loads needed for electrical distribution phase balance tests), or
3. Failure of owner-furnished, contractor-installed equipment to arrive on time. (Note that failure of the contractor’s supplier to deliver the correct material on time does not fall into this category.)

**OC-3. End-of-Warranty Period Evaluation/Tests:** End-of-warranty period evaluation/tests seek to identify failed equipment or systems before expiration of the warranty. Some or all of the commissioning tests performed during the Construction Phase may be repeated one or two months before the warranty period expiration. Contractors and designers should be invited to attend, but are not mandatory. Compare test results with Construction Phase test results to evaluate degradation of system functions. Prepare Commissioning Issue Report forms as needed. Contact the apparent responsible entity for corrective action.

**OC-4. Lessons-learned Workshop and Document:** After completion of the Construction Phase Commissioning Summary Report, convene a lessons-learned workshop to evaluate the Commissioning Process. Document the findings and distribute them to the appropriate UT organizations, the designers, the contractors and the Commissioning Authority.

**OC-5. Project Commissioning Report:** When deferred tests and end-of-warranty period evaluation/tests are complete, prepare a supplement to the Construction Phase Commissioning Summary Report. Together, the Construction Phase Commissioning Summary Report and the supplement, constitute the Project Commissioning Report. The Project Commissioning Report is the final commissioning report for the renovation project.

The Project Commissioning Report contains all documentation and correspondence related to the Commissioning Process. It is a complete record of the renovation project Commissioning Process and its results. Archive a copy of the report and file a copy where the operations and maintenance staff can reference it.

**OC-6. Recommissioning (Periodic):** Periodic recommissioning improves the persistence of the Commissioning Process. Recommissioning occurs as a scheduled activity. The frequency of the recommissioning process varies depending on the specifics of the system involved. Systems that are more critical warrant more frequent recommissioning; monthly in the extreme, yearly for systems such as fire alarm. Less critical systems may be scheduled for recommissioning on a 3- or 5- or 10-year frequency. Some, such as toilet exhaust systems, have minor impact when they fail, minor energy impacts, and
a robust feedback from occupants; may be handled on a breakdown response basis.

B. **Schedule**

*Project Manager: Fill in the schedules below to the best of your ability during Predesign. Adjust as necessary as the project proceeds.*

1. **Predesign Phase Schedule**

The following Predesign Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP-1.</td>
<td>Determine Cx Level</td>
<td></td>
<td></td>
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<tr>
<td>PP-2.</td>
<td>Adapt Model Cx Plan</td>
<td></td>
<td></td>
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<tr>
<td>PP-3.</td>
<td>Define Scope of Cx</td>
<td></td>
<td></td>
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<tr>
<td>PP-4.</td>
<td>Define Cx Team</td>
<td></td>
<td></td>
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<tr>
<td>PP-5.</td>
<td>Secure CxA (UT, consultant?)</td>
<td></td>
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<tr>
<td>PP-6.</td>
<td>Record &amp; Track Issues</td>
<td></td>
<td></td>
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<tr>
<td>PP-7.</td>
<td>Define Project Requirements (PR) Issues</td>
<td></td>
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<tr>
<td>PP-8.</td>
<td>Prompt for PR Performance Criteria</td>
<td></td>
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<tr>
<td>PP-9.</td>
<td>Review Lessons Learned</td>
<td></td>
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<tr>
<td>PP-10.</td>
<td>Establish Cx Budget</td>
<td></td>
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<tr>
<td>PP-11.</td>
<td>Determine Cx Schedule Expectations</td>
<td></td>
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<tr>
<td>PP-13.</td>
<td>Review Predesign documents vs. PR</td>
<td></td>
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<tr>
<td>PP-14.</td>
<td>Write Predesign Cx Report</td>
<td></td>
<td></td>
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<tr>
<td>PP-15.</td>
<td>Accept Predesign</td>
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</tbody>
</table>

2. **Design Phase Schedule**

The following Design Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP-1.</td>
<td>Validate Proposed PR Changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-2.</td>
<td>Update PR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-3.</td>
<td>Update Cx Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-4.</td>
<td>Record &amp; Track Issues</td>
<td></td>
<td></td>
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<tr>
<td>DP-5.</td>
<td>Write Basis of Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-6.</td>
<td>Review Basis of Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-7.</td>
<td>Design Review @ SD</td>
<td></td>
<td></td>
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<tr>
<td>DP-8.</td>
<td>Design Review @ DD</td>
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<td></td>
</tr>
<tr>
<td>DP-9.</td>
<td>Design Review @ CD</td>
<td></td>
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<tr>
<td>DP-12.</td>
<td>Write Cx Specifications</td>
<td></td>
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<tr>
<td>DP-13.</td>
<td>Write Draft Construction Checklists</td>
<td></td>
<td></td>
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<tr>
<td>DP-14.</td>
<td>Write Draft Cx Tests</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DP-15. Define Training Requirements  
DP-16. Write Design Phase Cx Report  
DP-17. Design Phase Document Acceptance  

3. **Bid / Acquisition Phase Schedule**  
The following Bid / Acquisition Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP-1</td>
<td>Discuss Cx Requirements at Pre-bid Mtg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP-2</td>
<td>Respond to Bidder Queries re Cx</td>
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<td></td>
</tr>
</tbody>
</table>

4. **Construction Phase Schedule**  
The following Construction Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP-1</td>
<td>Validate Proposed PR Changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-2</td>
<td>Update PR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-3</td>
<td>Update Basis of Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-4</td>
<td>Validate Updated Basis of Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-5</td>
<td>Update Cx Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-6</td>
<td>Update Systems Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-7</td>
<td>Verify Updated Systems Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-8</td>
<td>Coordinate UT Staff Involvement in Cx</td>
<td></td>
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<tr>
<td>CP-9</td>
<td>Finalize Cx Team Members</td>
<td></td>
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<tr>
<td>CP-10</td>
<td>Conduct Pre-construction Cx Meeting.</td>
<td></td>
<td></td>
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<tr>
<td>CP-11</td>
<td>Cx Review of Submittals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-12</td>
<td>Schedule Cx Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-13</td>
<td>Update Cx Schedule Weekly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-14</td>
<td>Finalize Cx Checklists</td>
<td></td>
<td></td>
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<tr>
<td>CP-15</td>
<td>Finalize Cx Test Procedures &amp; Data Forms.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-16</td>
<td>Periodic Cx Meetings</td>
<td></td>
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<tr>
<td>CP-17</td>
<td>Periodic Site Visits</td>
<td></td>
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<tr>
<td>CP-18</td>
<td>Fill Out Cx Checklists</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-19</td>
<td>Verify Cx Checklists</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-20</td>
<td>Execute Cx Tests</td>
<td></td>
<td></td>
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<tr>
<td>CP-21</td>
<td>Verify Test Data Reports.</td>
<td></td>
<td></td>
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<tr>
<td>CP-22</td>
<td>Witness/Validate Cx Tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-23</td>
<td>Verify Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-24</td>
<td>Issues: Identify, Track, Resolve</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. **Occupancy and Operations Phase Schedule**
The following Occupancy and Operations Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>OC-1.</td>
<td>Submit project to Warranty Team</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OC-2.</td>
<td>Deferred Testing</td>
<td></td>
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</tr>
<tr>
<td>OC-3.</td>
<td>End-of-Warranty Period Evaluation/Tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OC-4.</td>
<td>Lessons-learned Workshop &amp; Document</td>
<td></td>
<td></td>
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<tr>
<td>OC-5.</td>
<td>Project Cx Report</td>
<td></td>
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<tr>
<td>OC-6.</td>
<td>Recommissioning (Periodic)</td>
<td></td>
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</tbody>
</table>

IV **COMMISSIONING TEAM**

A. **Commissioning Team Membership**

1. **General**
   Complete the list of Commissioning Team members below with the names and organizations of the individuals who will be involved in the project.

2. **Owner**
   a. Project Manager:
   b. Commissioning Manager:
   c. Physical Plant:
      1. Architectural and Engineering Services:
      2. Planning and Construction:
      3. Building Maintenance:
      4. Pickle Research Campus:
   d. Occupants

3. **Designer**
   a. [Architectural and Engineering Services]:
   b. [Planning and Construction]:
   c. [Contract A/E]:

4. **Constructor**
   a. [In-house]:

<table>
<thead>
<tr>
<th>CP-25.</th>
<th>Cx Progress Reports</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CP-26.</td>
<td>Incorporate New Equipment into O&amp;M Program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-27.</td>
<td>Construction Acceptance</td>
<td></td>
<td></td>
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<tr>
<td>CP-28.</td>
<td>Construction Phase Cx Summary Report</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
 Planning and Construction:

(a) Project Manager (?):

b. [Contract]:

(1) General Contractor:
(2) Commissioning Technician:
(3) Subcontractor:
(4) Subcontractor:
(5) Subcontractor:

5. Commissioning Authority

a. [In-house]:

b. [Contract]:

B. Team Responsibilities

1. General

The following list presents an overview of the commissioning responsibilities of each commissioning team member. Appendix J, “Commissioning Team Responsibilities,” is a table that presents a view that focuses on how the responsibilities for each commissioning activity are distributed among team members.

a. Owner: As used here, the term “Owner” includes all UT entities; users, occupants, and Physical Plant. Physical Plant, through its several departments, provides project management and in some cases design and construction services.

(1) Project Manager (Physical Plant): The Project Manager plays a central role in the Commissioning Process. They initiate the Commissioning Process by determining the Commissioning Level, the scope of commissioning, and the commissioning budget. They procure, either from in-house resources or from contracted consultants, the services of the Commissioning Authority. They manage the work of the Commissioning Authority and provide the authority to support the Commissioning Authority’s recommendations.

(a) Determine Commissioning Level (PP-1) and adapt the Model Commissioning Plan (PP-2).
(b) Define scope of commissioning (PP-3) and commissioning team roster (PP-4).
(c) Assist CxM in procurement of Commissioning Authority services (PP-5).
(d) Identify issues to be addressed by the PR document (PP-7).
(e) Assist in soliciting input to performance criteria (PP-8).
(f) Lead review of lessons learned (PP-9).
(g) Establish commissioning budget (PP-10).
(h) Determine commissioning schedule expectations (PP-11).
(i) Review predesign document completion and compliance with PR (PP-13).
(j) Review predesign phase commissioning report (PP-14).
(k) Accept completion of Predesign work (PP-15).
(l) Act on CxA recommendations for proposed PR changes (DP-1).
(m) Review update of PR with accepted changes (DP-2).
(n) Review update of Commissioning Plan (DP-3).
(o) Review status of issues (DP-4).
(p) Review basis of design document (DP-6).
(q) Commissioning review of design documents at SD, DD, and CD (DP-7, DP-8, DP-9).
(r) Update systems manual (DP-10).
(s) Validate systems manual update (DP-11).
(t) Review commissioning specifications, draft construction checklists, and draft commissioning tests (DP-12, DP-13, DP-14).
(u) Review training requirements (DP-15).
(v) Review design phase commissioning report (DP-16).
(w) Accept completion of design phase work (DP-17).
(x) Discuss commissioning requirements at pre-bid meeting (BP-1).
(y) Review responses to bidder queries regarding commissioning (BP-2).
(z) Act on CxA recommendations for proposed PR changes (CP-1).
(aa) Review update of PR with accepted changes (CP-2).
(bb) Review updated basis of design document (CP-4).
(cc) Review update of Commissioning Plan (CP-5).
(dd) Review update of systems manual (CP-7).
(ee) Coordinate UT staff involvement in commissioning (CP-8).
(ff) Provide input to commissioning team roster (CP-9).
(gg) Attend pre-construction commissioning meeting (CP-10).
(hh) Review commissioning submittals (CP-11).
(ii) Review commissioning schedules (CP-12, CP-13).
(jj) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(kk) Attend periodic commissioning meetings (CP-16).
(ll) Review commissioning issues (CP-24).
(mm) Review commissioning progress reports (CP-25).
(nn) Issue certificate of functional completion (CP-27).
(oo) Lead review of construction phase commissioning report (CP-28).
(pp) Coordinate contractor callbacks (OC-1).
(qq) Attend lessons-learned workshop (OC-4).
(rr) Review project commissioning report (OC-05).

(2) Building Maintenance (Physical Plant): Building Maintenance, however, does have a unique role in the Commissioning Process. As the operators and maintainers of facilities, they are long-term stakeholders in the success of the Commissioning Process. Consequently, Building Maintenance reviews the design, the Commissioning Authority’s work, and the contractor’s
submittals, participates in site visits, witnesses tests, and are the recipients of training.

(a) Review determination of Commissioning Level (PP-1).
(b) Review scope of commissioning (PP-3) and commissioning team roster (PP-4).
(c) Review candidates for Commissioning Authority services (PP-5).
(d) Identify issues to be addressed by the PR document (PP-7).
(e) Provide input to determine performance criteria (PP-8).
(f) Review lessons learned (PP-9).
(g) Review commissioning schedule expectations (PP-11).
(h) Provide input to systems manual requirements (PP-12).
(i) Review predesign document completion and compliance with PR (PP-13).
(j) Review predesign phase commissioning report (PP-14).
(k) Review completion of Predesign work (PP-15).
(l) Review proposed PR changes (DP-1).
(m) Review update of PR with accepted changes (DP-2).
(n) Review status of issues (DP-4).
(o) Review basis of design document (DP-6).
(p) Commissioning review of design documents at SD, DD, and CD (DP-7), (DP-8), (DP-9).
(q) Validate systems manual update (DP-11).
(r) Review commissioning specifications, draft construction checklists, and draft commissioning tests (DP-12, DP-13, DP-14).
(s) Define training requirements (DP-15).
(t) Review design phase commissioning report (DP-16).
(u) Review recommendation to accept design phase work (DP-17).
(v) Review responses to bidder queries regarding commissioning (BP-2).
(w) Review proposed construction phase PR changes (CP-1) and review documentation of same (CP-2).
(x) Review updated basis of design document (CP-4).
(y) Review update of Commissioning Plan (CP-5).
(z) Lead review of update of systems manual (CP-7).
(aa) Handle requests for UT staff involvement in commissioning (CP-8).
(bb) Provide input to commissioning team roster (CP-9).
(cc) Attend pre-construction commissioning meeting (CP-10).
(dd) Review commissioning submittals (CP-11).
(ee) Review commissioning schedules (CP-12), (CP-13).
(ff) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(gg) Attend periodic commissioning meetings (CP-16).
(hh) Make periodic site visits (CP-17).
(ii) Review completed commissioning checklists (CP-19).
(jj) Review completed commissioning test data reports (CP-21).
(ll) Attend training (CP-23).
(mm) Review commissioning issues (CP-24).
(nn) Review commissioning progress reports (CP-25).
(oo) Incorporate new equipment into O&M program (CP-26).
(pp) Review request for certificate of functional completion (CP-27).
(qq) Review construction phase commissioning report (CP-28).
(rr) Coordinate contractor callbacks (OC-1).
(ss) Assist in performing deferred commissioning tests and end-of-warranty evaluation/tests (OC-2, OC-3).
(tt) Attend lessons-learned workshop (OC-4).
(uu) Review project commissioning report (OC-05).
(vv) Perform periodic recommissioning (OC-6).

(3) Users and occupants: Users and occupants determine the need for a renovation project and define the Project Requirements. In some cases, they will also receive training in the use of the renovated facility.

(a) Identify issues to be addressed by the PR document (PP-7).
(b) Provide input to determine performance criteria (PP-8).
(c) Review lessons learned (PP-9).
(d) Review recommendation to accept predesign documents (PP-15).
(e) Review proposed design phase PR changes (DP-1) and review documentation of same (DP-2).
(f) Review design issues (DP-4).
(g) Review recommendation to accept design phase work (DP-17).
(h) Review proposed construction phase PR changes (CP-1) and review documentation of same (CP-2).
(i) Attend occupant/user training (CP-23).
(j) Review construction phase commissioning report (CP-28).
(k) Attend lessons-learned workshop (OC-4).

(4) Commissioning Manager (CxM): The CxM is a UT staff member responsible for the overall renovation project commissioning program at UT.

The CxM provides technical assistance to Project Managers on commissioning issues, particularly during predesign. The CxM reviews the determination of Commissioning Level for the project, reviews the adaptation of the appropriate Model Commissioning Plan and assists in defining the project Commissioning Team. Because these activities may occur before the Commissioning Authority is available to the Project Manager, the CxM provides the continuity and expertise that the Commissioning Authority would otherwise provide.

The CxM is normally not the Commissioning Authority for the project. The CxM, however, does take the lead in securing the services of the Commissioning Authority.

The CxM tracks resolution of issues and reviews results of the end-of-
warranty evaluation. The CxM uses this information to evaluate the commissioning process and identify areas requiring increased (or reduced) commissioning attention in the Model Commissioning Plans.

The CxM monitors application of the commissioning process to renovation projects, tracks costs, benefits and lessons learned, recommends changes to the UT commissioning process, and is an advocate for the program.

(a) Review determination of Commissioning Level (PP-1) and adaptation of the Model Commissioning Plan (PP-2).
(b) Review scope of commissioning (PP-3) and commissioning team roster (PP-4).
(c) Lead procurement of Commissioning Authority services (PP-5).
(d) Review identification of PR issues (PP-7).
(e) Assist in soliciting input to performance criteria (PP-8).
(f) Review lessons learned (PP-9).
(g) Review predesign document completion and compliance with PR (PP-13).
(h) Review predesign phase commissioning report (PP-14).
(i) Review commissioning specifications, draft construction checklists, and draft commissioning tests (DP-12, DP-13, DP-14)
(j) Review design phase commissioning report (DP-16).
(k) Monitor coordination of UT staff participation in commissioning (CP-8).
(l) Review commissioning team roster (CP-9).
(m) Attend pre-construction commissioning meeting (CP-10).
(n) Review commissioning schedules (CP-12), (CP-13).
(o) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(p) Maintain database of issues (CP-24).
(q) Review construction phase commissioning report (CP-28).
(r) Review results of end-of-warranty evaluation and tests (OC-3).
(s) Attend lessons learned workshop (OC-4).

b. Commissioning Authority: Again, regardless of whether the Commissioning Authority is an in-house entity, or an outside consultant, their commissioning roles are similar. The Commissioning Authority provides UT with an unbiased evaluation of the functional quality of the renovation project. The Commissioning Authority scope of work includes:

(a) Assist the PM in defining scope of commissioning (PP-3) and commissioning team roster (PP-4).
(b) Record and track issues (PP-6).
(c) Facilitate discussion and record identification of issues to be addressed by the PR document (PP-7).
(d) Facilitate Project Requirements workshops to solicit input to performance criteria (PP-8).
(e) Review lessons learned (PP-9).
(f) Advise PM on establishing commissioning budget (PP-10).

(g) Determine commissioning schedule expectations (PP-11).

(h) Assemble systems manual (PP-12).

(i) Lead review of predesign document completion and compliance with PR (PP-13).

(j) Write predesign phase commissioning report (PP-14).

(k) Recommend acceptance of completion of Predesign work (PP-15).

(l) Validate proposed PR changes (DP-1).

(m) Update PR with accepted changes (DP-2).

(n) Update Commissioning Plan (DP-3).

(o) Record and track status of issues (DP-4).

(p) Review basis of design document (DP-6).

(q) Commissioning review of design documents at SD, DD, and CD (DP-7), (DP-8), (DP-9).

(r) Assemble update of systems manual (DP-10).

(s) Write commissioning specifications, draft construction checklists, and draft commissioning tests (DP-12, DP-13, DP-14).

(t) Document training verification requirements in specifications (DP-15).

(u) Write design phase commissioning report (DP-16).

(v) Recommend acceptance of completion of design phase work (DP-17).

(w) Lead discussion of commissioning requirements at pre-bid meeting (BP-1).

(x) Lead response to bidder queries regarding commissioning (BP-2).

(y) Validate proposed PR changes (CP-1).

(z) Update PR with accepted changes (CP-2).

(aa) Lead review of updated basis of design document (CP-4).

(bb) Assemble update of systems manual (CP-6).

(cc) Lead coordination of UT staff involvement in commissioning (CP-8).

(dd) Create commissioning team roster (CP-9).

(ee) Conduct pre-construction commissioning meeting (CP-10).

(ff) Lead review of commissioning submittals (CP-11).

(gg) Lead review of commissioning activities schedules (CP-12, CP-13).

(hh) Finalize commissioning checklists and test procedures (CP-14, CP-15).

(ii) Lead periodic commissioning meetings (CP-16).

(jj) Make periodic site visits (CP-17).

(kk) Lead review of completed commissioning checklists (CP-19).

(ll) Lead review of completed commissioning test data reports (CP-21).

(mm) Lead witnessing of performance of commissioning tests (CP-22).

(nn) Verify training (CP-23).

(oo) Lead identification, tracking and resolution of commissioning issues (CP-24).

(pp) Write commissioning progress reports (CP-25).

(qq) Lead review of request for certificate of functional completion (CP-27).
(rr) Write construction phase commissioning report (CP-28).
(ss) Lead coordination of contractor callbacks (OC-1).
(tt) Direct performance of deferred commissioning tests and end-of-warranty evaluation/tests (OC-2, OC-3).
(uu) Lead lessons-learned workshop and document results (OC-4).
(vv) Write project commissioning report (OC-05).
(ww) Assist with periodic recommissioning (OC-6).

c. Designer: Regardless of whether the design professional, i.e. the architect and engineering consultants, is an in-house entity, or an outside consultant, their commissioning roles are similar. In general the designer is tasked to:

(1) Architect:

(a) Identify issues to be addressed by the PR document (PP-7). (If available during this activity.)
(b) Review update of PR with accepted changes (DP-2).
(c) Review update of Commissioning Plan (DP-3).
(d) Respond to design issues (DP-4).
(e) Write basis of design document (DP-5).
(f) Respond to comments on basis of design document (DP-6).
(g) Respond to commissioning review of design documents at SD, DD, and CD (DP-7), (DP-8), (DP-9).
(h) Update systems manual (DP-10).
(i) Coordinate commissioning specifications, draft construction checklists, and draft commissioning tests with CxA (DP-12, DP-13, DP-14).
(j) Incorporate training requirements in specifications (DP-15).
(k) Review design phase commissioning report (DP-16).
(l) Discuss commissioning requirements at pre-bid meeting (BP-1).
(m) Handle responses to bidder queries regarding commissioning (BP-2).
(n) Review update of PR with accepted changes (CP-2).
(o) Lead update of basis of design document (CP-3).
(p) Respond to review of updated basis of design document (CP-4).
(q) Review update of Commissioning Plan (CP-5).
(r) Review update of systems manual (CP-7).
(s) Provide input to commissioning team roster (CP-9).
(t) Attend pre-construction commissioning meeting (CP-10).
(u) Handle submittal and review of commissioning submittals (CP-11).
(v) Review commissioning schedules (CP-12), (CP-13).
(w) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(x) Attend periodic commissioning meetings (CP-16).
(y) Review completed commissioning test data reports (CP-21).
(z) Review commissioning issues (CP-24).
(aa) Review request for certificate of functional completion (CP-27).
(bb) Review construction phase commissioning report (CP-28).
(cc) Attend performance of deferred commissioning tests and end-of-warranty evaluation/tests (OC-2, OC-3).
(dd) Attend lessons-learned workshop (OC-4).

(2) Consultants (Engineers):

(a) Identify issues to be addressed by the PR document (PP-7). (If available during this activity.)
(b) Review update of PR with accepted changes (DP-2).
(c) Review update of Commissioning Plan (DP-3).
(d) Respond to design issues (DP-4).
(e) Write basis of design document (DP-5).
(f) Respond to comments on basis of design document (DP-6).
(g) Respond to commissioning review of design documents at SD, DD, and CD (DP-7), (DP-8), (DP-9).
(h) Update systems manual (DP-10).
(i) Coordinate commissioning specifications, draft construction checklists, and draft commissioning tests with CxA (DP-12, DP-13, DP-14).
(j) Incorporate training requirements in specifications (DP-15).
(k) Review design phase commissioning report (DP-16).
(l) Discuss commissioning requirements at pre-bid meeting (BP-1).
(m) Respond to bidder queries regarding commissioning (BP-2).
(n) Review update of PR with accepted changes (CP-2).
(o) Update basis of design document (CP-3).
(p) Respond to review of updated basis of design document (CP-4).
(q) Review update of Commissioning Plan (CP-5).
(r) Review update of systems manual (CP-7).
(s) Provide input to commissioning team roster (CP-9).
(t) Attend pre-construction commissioning meeting (CP-10).
(u) Review commissioning submittals (CP-11).
(v) Review commissioning schedules (CP-12), (CP-13).
(w) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(x) Attend periodic commissioning meetings (CP-16).
(y) Review completed commissioning test data reports (CP-21).
(z) Review commissioning issues (CP-24).
(aa) Review request for certificate of functional completion (CP-27).
(bb) Review construction phase commissioning report (CP-28).
(cc) Attend performance of deferred commissioning tests and end-of-warranty evaluation/tests (OC-2, OC-3).
(dd) Attend lessons-learned workshop (OC-4).

d. Constructor: Regardless of whether the constructor, including subcontractors or in-house shops, is an in-house entity, or an outside contractor, their commissioning roles are similar. For Level 1 Commissioning projects the constructor designates someone to manage and coordinate the commissioning work, referred to as the “Commissioning Technician.”
(1) General Contractor (GC):

(a) Review update of PR with accepted changes (CP-2).
(b) Review updated basis of design document (CP-4).
(c) Review update of Commissioning Plan (CP-5).
(d) Submit materials for update of systems manual (CP-6).
(e) Submit input to commissioning team roster (CP-9).
(f) Attend pre-construction commissioning meeting (CP-10).
(g) Submit and respond to review of commissioning submittals (CP-11).
(h) Prepare and submit commissioning activities schedules (CP-12, CP-13).
(i) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(j) Attend periodic commissioning meetings (CP-16).
(k) Submit completed commissioning checklists (CP-18).
(l) Submit completed commissioning test data reports (CP-20).
(m) Provide training (CP-23).
(n) Manage response to commissioning issues (CP-24).
(o) Handle O&M submittals (CP-25).
(p) Submit request for certificate of functional completion (CP-27).
(q) Review construction phase commissioning report (CP-28).
(r) Attend performance of deferred commissioning tests and end-of-warranty evaluation/tests (OC-2, OC-3).
(s) Attend lessons-learned workshop (OC-4).

(2) Commissioning Technician (CxT): The CxT coordinates and manages commissioning work for the GC.

(a) Review update of PR with accepted changes (CP-2).
(b) Review updated basis of design document (CP-4).
(c) Review update of Commissioning Plan (CP-5).
(d) Review materials for update of systems manual before GC submittal (CP-6).
(e) Coordinate UT staff involvement in commissioning (CP-8).
(f) Review contractor input to commissioning team roster (CP-9).
(g) Attend pre-construction commissioning meeting (CP-10).
(h) Assemble and submit commissioning submittals (CP-11).
(i) Provide input to commissioning activities schedules (CP-12, CP-13).
(j) Review final commissioning checklists and test procedures (CP-14, CP-15).
(k) Attend periodic commissioning meetings (CP-16).
(l) Review and submit completed commissioning checklists (CP-18).
(m) Direct and manage performance of commissioning tests (CP-20).
(n) Record and submit commissioning test data reports (CP-20).
(o) Provide training (CP-23).
(p) Report, track, and direct response to commissioning issues (CP-24).
(q) Prepare request for certificate of functional completion (CP-27).
(r) Review construction phase commissioning report (CP-28).
(s) Attend lessons-learned workshop (OC-4).

(3) Subcontractors: Actions listed below are performed by subcontractors to the GC. Therefore, all actions flow through the GC.

(a) Review update of PR with accepted changes (CP-2).
(b) Review updated basis of design document (CP-4).
(c) Review update of Commissioning Plan (CP-5).
(d) Submit materials for update of systems manual (CP-6).
(e) Provide input to commissioning team roster (CP-9).
(f) Attend pre-construction commissioning meeting (CP-10).
(g) Prepare submittals and respond to review of commissioning submittals (CP-11).
(h) Provide input to commissioning activities schedules (CP-12, CP-13).
(i) Review final commissioning checklists and test procedures (CP-14, CP-15).
(j) Attend periodic commissioning meetings (CP-16).
(k) Complete commissioning checklists (CP-18).
(l) Review completed commissioning test data reports (CP-19).
(m) Perform commissioning tests (CP-20).
(n) Provide training (CP-23).
(o) Respond to commissioning issues (CP-24).
(p) Prepare O&M submittals (CP-25).
(q) Review construction phase commissioning report (CP-28).
(r) Attend performance of deferred commissioning tests and end-of-warranty evaluation/ tests (OC-2, OC-3).
(s) Attend lessons-learned workshop (OC-4).

(4) Suppliers: Actions listed below are performed by suppliers to subcontractors or to the GC. Therefore, all actions flow through the subcontractors and the GC.

(a) Review update of PR with accepted changes (CP-2).
(b) Review updated basis of design document (CP-4).
(c) Review update of Commissioning Plan (CP-5).
(d) Submit materials to contractor for update of systems manual (CP-6).
(e) Provide input to commissioning team roster (CP-9).
(f) Prepare submittals and respond to review of commissioning submittals (CP-11).
(g) Provide input to commissioning activities schedules (CP-12, CP-13).
(h) Review final commissioning checklists and test procedures (CP-14, CP-15).
(i) Attend periodic commissioning meetings when required by GC (CP-16).
(j) Perform commissioning tests (CP-20).
(k) Provide training (CP-23).
(l) Attend performance of deferred commissioning tests and end-of-warranty evaluation/ tests (OC-2, OC-3).
C. **Team Communication**

1. **Formal**
   Formal communications convey changes in scope, schedule, and/or price. Formal commissioning communications follow established contract lines: direction to make changes can only be made by the entity that holds the contract. Since the Commissioning Authority is under contract to the UT project manager (or is a staff member working under the project manager’s direction), the Commissioning Authority cannot and must not direct changes to the work of the design professional nor to the work of the constructor. The Commissioning Authority must only make recommendations to the project manager regarding changes they believe are necessary.

2. **Informal**
   While formal communications protocol is essential in matters of scope, schedule, and price, there are numerous other topics that do not require the cumbersome chain of command. Informal communications between the Commissioning Authority and the design engineer or a subcontractor can expedite solutions to issues and make coordination easier, provided the design prime (architect) or the general contractor will allow their subs to participate. Frequently informal communication quickly establishes a mutually acceptable solution to a difficult issue, which is then translated into a change of work through formal channels.

V  **SCOPE OF COMMISSIONING**

Two primary elements of the scope of commissioning are the list of “equipment and systems,” and the list of “functions and features” associated with each piece of equipment of system.

A. **Equipment & Systems**
   The following equipment and systems are included in the scope of the Commissioning Process for this project. The Preface contains guidance on ranking equipment and systems. List here the highest ranked systems and equipment. The headings are suggestions and should be edited to suit the project.

B. **Functions and Features**
   For each piece of equipment or system included in the scope of commissioning, determine which functions and features should be evaluated by the Commissioning Process. Functions and features selected for inclusion in the scope of commissioning for each item of equipment and systems are listed in parenthesis following the item in the list below.

1. **General Construction**
   a. Automatic Shading (response to movement of the sun, reduction of solar gain)
   b. 
   c. 

2. **Mechanical Systems**
3. **Electrical Systems**
   a. New Elevator Controls (response to call, response to send, firefighter override, response to fire alarm, response to loss of normal power)

VI **DOCUMENTATION**

A. **General**
The preceding text refers to a number of commissioning-related documents. The following is a brief discussion of the characteristics of the commissioning-related documents.

1. **Project Requirements**
   A document that details the functional requirements of a project and the expectations of its use and operation. Included are project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

2. **Commissioning Plan**
   A document that summarizes the scope of commissioning, organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.

3. **Systems Manual**
   A document that includes the operations manual, the maintenance manual and additional information of use to the owner and operators throughout the life of the facility. It contains the traditional O&M manual materials plus the documentation generated by the Commissioning Process, organized in a systems-oriented manner to make it useful for quick reference.

4. **Basis of Design**
   A document that records the concepts, calculations, decisions and rationales for those decisions, and product selections used to meet the Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The Basis of Design includes narrative descriptions and lists of individual items that support the design process.

5. **Commissioning Specifications**
   The portion of the bid documents that describes the contractor’s duties and responsibilities in support of the Commissioning Process. The commissioning specifications include draft Construction Checklists and draft Test Procedures.
   a. Construction Checklists are checklists of installation quality and operational integrity used to verify that the Project Requirements are being achieved.
   b. Test Procedures are the detailed instructions for conducting commissioning tests.
1) **Static tests:** Most static tests are already included in standard specifications. They should be consolidated and managed under the commissioning process. Common static tests include pipe and duct leak tests, and cable insulation integrity tests.

2) **Component tests:** Components are simple assemblies that are usually input or output devices in control systems, such as sensors, actuators, switches and relays. Verification of component functions is essential to the success of equipment and system functions. The intensity of the test procedures depends on the function of the component. For example, a temperature sensor in a process chilled water system might be calibrated at three temperatures, while a room temperature sensor might only be checked at a single temperature.

3) **Equipment/Assembly tests:** Equipment and assemblies include complex machines such as boilers, cooling towers, emergency power generators. They frequently include on-board controls. In addition to the normal start-up procedures, other control and performance functions should be tested.

4) **System tests:** Systems include, for example, chilled water, fire alarm, building envelope or access security systems. System functions tend to be complex and involve control of multiple components, pieces of equipment, and assemblies. Tests include all normal operation functions under a full range of loads, emergency operation functions in response to all emergency conditions, transitional control, and schedule control.

5) **Intersystem tests:** These are the most difficult tests to execute because they involve the operation of the work of multiple trades. Verify the response of one or more systems to a condition in another system. Verify the ability to deliver the intended effect to the point of use. Intersystem tests verify the design as well as the coordination of the work of the contractors. Examples include the ability to maintain temperature and humidity in a space under varying load conditions, or the response of the HVAC control system to loss and restoration of normal power.

These are the last tests performed. Some of them, like the space temperature and humidity control, may require that all work be completed, including door adjustment and seals, ceiling tile installation, carpet installation, and fully cured finishes. In such cases, these tests may add a few days to a large project schedule before move-in.

   A document that summarizes the activities and results of the Commissioning Process, and recommends subsequent action.

7. **Commissioning Schedule**
   A chronological listing of commissioning activities, including the duration of each, and precedent and dependent events.
a. Integrated Commissioning Schedule: A listing of commissioning activities in the context of the overall project schedule. Most importantly, the construction phase commissioning schedule integrates commissioning activities with construction activities and ties them together with precedents and dependencies.

b. Two-week Look-ahead Schedule: A detailed schedule of commissioning activities in the coming two-week period. Used during the commissioning testing period to inform Commissioning Team members of the exact date, time and location of commissioning tests and other commissioning activities requiring field coordination.

8. Lessons Learned Document
   A document of the results of the lessons learned workshop.

9. Issues Log
   A formal, continuously updated record of problems and concerns, and their resolution, as identified by Commissioning Team members throughout the Commissioning Process.
MODEL COMMISSIONING PLAN – LEVEL 2

Renovation Project Master Commissioning Plan

Note: This document contains “hidden text,” which should be displayed in BLUE. If you do not see blue text in this document, it can be turned on in MS Word by pulling down the Tools menu and selecting Options. In the Options window, select the View tab. Under Nonprinting characters select the Hidden text option. Then click OK.

Hidden text is set NOT to print. However, if it does print, go to the Tools/Options window. On the Print tab under Include with document, turn off the Hidden text selection.
I INTRODUCTION

A. Purpose of this Model Commissioning Plan

1. This Commissioning Plan describes the Level 2 commissioning process for [project name]. It describes the organization, responsibilities, and documentation of the Commissioning Process.

   • This “Model” Commissioning Plan for the Level 2 commissioning process is the framework for development of the “Project” Commissioning Plan. By turning off viewing of the hidden text in this document, and replacing bracketed fields […] with project-specific information, the remaining text is the first draft of the “Project” Commissioning Plan.

   • The “Model” Commissioning Plan describes the elements of the Commissioning Process in general terms applicable to projects assigned a Level 2 Commissioning Process status, without regard to the requirements of any specific project. The “Project” Commissioning Plan describes those project-specific requirements.

2. This Commissioning Plan is a communication and planning tool. It is not a contract document. Responsibilities described must be incorporated in the contracts with the various Commissioning Team members.

B. Scope

1. The Commissioning Plan describes the following elements of the Commissioning Process:

   • Commissioning Process from predesign through occupancy,
   • Commissioning team responsibilities during each phase of the project,
   • Scope of the commissioning process in terms of the equipment and systems to which the process applies, and in terms of the types of functions and features of interest for the included equipment and systems, and
   • Documentation requirements in each phase of the project.

Use of the Model Commissioning Plan

• This Level 2 Model Commissioning Plan is part of a graded approach to the commissioning of renovation projects. It applies to projects assigned to the Level 2 Commissioning Process.

• This is a “Model” Commissioning Plan for renovation projects. It is a template that outlines a generic Level 2 Commissioning Process. Use this Model Commissioning Plan
to generate project-specific Commissioning Plans for projects assigned to the Level 2 Commissioning Process.

- Use the companion “Model” Commissioning Plans for Level 1, Level 3 and Level 4 Commissioning Process projects.
- This “Model” Commissioning Plan should be reviewed and updated periodically as UT gains experience with the application of the Commissioning Process to renovation projects.
- This “Model” Commissioning Plan is not intended for application to Capital Projects, which are larger, proceed at a different pace, and command more resources.

**Background**

- Physical Plant decided to apply the commissioning process to improve the quality of renovation projects as an element of the Renovation Project Delivery Enhancement Program (RPDEP). The Process Action Team (F-PAT) charged with developing Theme #6, Institutional Stewardship and Commissioning, developed this Model Commissioning Plan with the support of Casualt Engineering.

**C. Objectives of the Commissioning Process**

- Clearly document Project Requirements.
- Improve delivery of renovation projects.
- Improve maintainability and service life.
- Optimize resource consumption.
- Minimize negative impacts on the campus, surrounding buildings, and existing systems.

**D. Definition of Commissioning Process**

1. A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its system and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s Project Requirements. (ASHRAE Guideline 0-2005)

## II  **QUALITY PHILOSOPHY**

**A. Quality Control**

1. The Commissioning Process, at all Levels, holds the owner, operator/maintainer, designer, contractor, manufacturer and installer fully accountable for the quality of their work. Each of these commissioning team members must manage and control the quality of their work continuously. Only the people doing the work can create quality.

**B. Quality Assurance**

1. The Commissioning Process evaluates the effectiveness of the management and control of quality by the people doing the work.
2. The Commissioning Process is not a substitute for quality control. Diligently resist attempts to subvert the quality assurance function of the Commissioning Process into a substitute for quality control. Any such tendency increases the cost of the Commissioning Process and reduces its effectiveness. When the people doing the work are not held accountable for the quality of their work, quality declines markedly.

3. When design firms working for a major university figured out that the university engineers’ reviews were extensive, the designers became lax in checking the quality of the work before submitting it for review. They knew that the university staff would identify their errors for them.

III  COMMISSIONING PROCESS

A. Commissioning Activities by Phase

1. This section of the Model Commissioning Plan is a description of commissioning tasks specific to the Level 2 Commissioning Process for this project. The Commissioning Team section of this Model Commissioning Plan describes the responsibilities for each of these tasks. Tasks are listed in approximately sequential order, with earliest tasks listed first.

2. Predesign Phase

   PP-1. Determine Commissioning Level: To determine the appropriate commissioning level for a project, follow these three steps, in this order:

   (1) Evaluate risk as described in the Preface.
   (2) Evaluate complexity as described in the Preface.
   (3) Select the commissioning level based on the table below. Select the Commissioning Level corresponding to the highest rated factor. A medium risk/low complexity project would be Level 2, for example.

<table>
<thead>
<tr>
<th>High risk or high complexity</th>
<th>Commissioning Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium risk or medium complexity</td>
<td>Commissioning Level 2</td>
</tr>
<tr>
<td>Low risk or low complexity</td>
<td>Commissioning Level 3</td>
</tr>
<tr>
<td>Very low risk and very low complexity</td>
<td>Commissioning Level 4</td>
</tr>
</tbody>
</table>

See the Preface for a discussion of determining the appropriate Commissioning Level for a project.

The Commissioning Level for this Project is Level 2. If this project is not Level 2, then use the Model Commissioning Plan that corresponds to whichever Level is determined.

Risk:  [High] [Medium] [Low] [Very Low]. Select the risk level for this project. Delete other levels. This Level 2 Commissioning Plan is not suitable for
High Risk projects.
Complexity: [High] [Medium] [Low] [Very Low]. Select the complexity level for this project. Delete other levels. This Level 2 Commissioning Plan is not suitable for High Complexity projects.

Record the Commissioning Level in the PR document and attach the Risk Evaluation Matrix and the Complexity Evaluation Matrix to this Commissioning Plan.

PP-2. Adapt Model Commissioning Plan: When the Commissioning Level has been assigned, use the corresponding Model Commissioning Plan as a guide to the commissioning process. Save a copy of the Model Commissioning Plan as the new [Project] <project name> Commissioning Plan. Edit the [Project] Commissioning Plan to reflect the specifics of the project to the extent possible at this point in the project. The edited document is the first draft of the [Project] Commissioning Plan.

PP-3. Define Scope of Commissioning: To the extent possible, define the scope of commissioning. There are two elements of the scope of commissioning. The first is a list of equipment and systems anticipated to be included in the project that should be commissioned. The second element is a list of functions or features of the selected equipment or systems that should be commissioned. At this point in the project, the list of equipment and systems can probably be anticipated with reasonable confidence. However, the functions and features element is probably best left until the Commissioning Authority is on board and the design develops. Use this information to edit the “Scope of Commissioning” section of the [Project] Commissioning Plan.

PP-4. Define Commissioning Team: Edit the Team Membership paragraph under the “Commissioning Team” section of the Model Commissioning Plan to reflect the actual organizations and individuals who will participate on the Commissioning Team. Some information may not be available until later.

Determining who will provide the services of the Commissioning Authority is a particularly urgent decision. The Commissioning Authority may either be an in-house resource or contracted PSP.

PP-5. Secure Commissioning Authority: Immediately after determining how the services of the Commissioning Authority will be acquired, initiate the process of getting them involved in the project. If an in-house resource is appropriate, notify the organization or individual promptly. If a contracted resource is needed, work with Business Services to expedite the selection and procurement of the commissioning professional. Delay of the procurement of the Commissioning Authority results in lost opportunities and higher commissioning costs.
PP-6. **Record and Track Issues**: As issues are identified, record them and track their status until each is satisfactorily resolved. Appendix F contains a Commissioning Issue Report Form.

PP-7. **Define Project Requirements (PR) Issues**: Convene a meeting/workshop of all stakeholders to identify which issues to include in the PR document. Make sure input is effectively elicited from all stakeholders. Record all issues in the PR document. To the extent possible get input on performance criteria also. See the discussion of the PR document under the “Documentation” section.

Note: Incorporate development of the PR issues and the associated performance criteria with project programming. Project Requirements are essential elements of the project program.

**Workshop Format**: The facilitator (typically the Commissioning Authority) elicits input from all project stakeholders. The following format has proven effective:

1. **Present open-ended questions**, or broad concepts, to the group. Questions should be sufficiently broad and open-ended to elicit a wide range of responses. All discussions and comments are treated as confidential, and are not to be repeated outside of the workshop.

2. For each subject or question, ask each participant to take three to five minutes to write down as many responses as they can.

3. Record individual responses in a round-robin session, asking each person in turn to share one of their responses. Do not allow discussion at this point, except as necessary for the facilitator to be able to record the response accurately. Record responses on something that all can read (flip charts, erasable boards, PC projector, etc.).

4. Review and clarify all responses, so everyone has a common understanding of each response. Combine similar responses.

5. Ask participants to rank the responses on a scale of 1 to 5.

6. Determine a group ranking based on the combined individual responses. Discuss the top ten or so responses to further clarify and gain any additional insight. As a group, decide how many of the responses should become project requirements. The top-ranked responses from each subject become the project requirements.

PP-8. **Prompt for PR Performance Criteria**: Beginning with the effort to define the PR issues, prompt stakeholders for performance criteria for each PR issue. Additional meetings and correspondence may be needed to complete the criteria. Some performance criteria require input from design specialists who are not yet involved in the project. Record performance criteria in the PR document.

Note: The facilitator of the workshop should encourage participants to focus on defining the issues clearly and establishing measurable acceptance criteria. Avoid the tendency to drift into problem-solving discussions. Problem-solving is the design professional’s responsibility.
PP-9. **Review Lessons Learned:** Apply the principles of continuous improvement to the Commissioning Process. Start by reviewing lessons learned on other projects. Use the results to improve the PR document and criteria, and the Project and Model Commissioning Plans. Record changes required for this project in the PR document.

PP-10. **Establish Commissioning Budget:** Past experience with similar projects is the best basis for estimating the commissioning budget. When suitable project experience is not available, use rules of thumb to estimate the commissioning budget, and solicit input from the Commissioning Authority. Record the commissioning budget in the PR document.

PP-11. **Determine Commissioning Schedule Expectations:** Include schedule expectations in the PR document. During Predesign, it is sufficient to state whether there is any reason to believe that the Commissioning Process may add any time either to the Design or Construction Phase schedule. Normally, the Commissioning Process should add no time to the schedule except perhaps a couple of days for final intersystem tests after the last finishes are complete. Record the commissioning schedule expectations in the PR document.

PP-12. **Initiate Systems Manual:** Establish the table of contents during Predesign and add documentation generated during this phase. Set up the Systems Manual to allow for easy addition of new materials as they become available in later phases.

PP-13. **Review Predesign Documents:** Before closing the Predesign phase, review the PR document for completeness and clarity of performance criteria. Review other documents created during Predesign to verify conformance with the PR document. Other documents include the Project Commissioning Plan, and commissioning-related scope of work statements included in the contracts for the Commissioning Authority and designers.

PP-14. **Write Predesign Commissioning Report:** At the conclusion of the Predesign phase, a brief commissioning report summarizes the commissioning activities and issues. If all issues have been satisfactorily resolved, the report recommends acceptance of the Predesign phase work.

PP-15. **Accept Predesign:** If the Predesign Commissioning Report recommends accepting the Predesign phase work, and if all other Predesign activities have been completed satisfactorily, the Predesign Phase work should be accepted, with authorization to proceed to Design Phase work.

3. **Design Phase**
The Design Phase commences with the design team’s receipt of the notice to proceed and ends with the issuance of bidding documents.

For the purpose of Model Commissioning Plan, the Design Phase consists of three sub-phases: Schematic Design (SD), Design Development (DD), and Contract Documents (CD). In some projects, these sub-phases may blur or be combined, depending on project management needs. Adjust the terminology in this section accordingly.
DP-1. **Validate Proposed PR Changes:** Changes to Project Requirements made after the Predesign Phase pose a high risk to the success of the project. Late PR changes typically do not receive the same attention and are not subject to the same series of checks as those made during Predesign. The subtle ramifications of seemingly innocent PR changes are easy to overlook. Therefore, it is important to review carefully any proposed PR changes for their impact on the operation of the facility or systems. PR changes should be approved by all stakeholders before being incorporated into the PR Document.

DP-2. **Update PR Document:** While the goal is to fully define and document Project Requirements during the Predesign Phase, changes may be necessary as the project progresses. When Project Requirements change or are defined further, update the PR Document. Review the PR Document for necessary changes at the beginning and at the end of the Design Phase. Track changes to the PR Document using standard word processing software tracking tools. Insert notes to explain why changes were made.

DP-3. **Update Commissioning Plan:** Update the Project Commissioning Plan *(this document)* to reflect changes to the Commissioning Level, scope of commissioning, and Commissioning Team membership. As noted in the Predesign Phase discussion of the scope of commissioning, systems and equipment may need updating, but functions and features will almost certainly need updating during the Design Phase.

DP-4. **Record and Track Issues:** Record issues when they are identified. Track their status until each is satisfactorily resolved. Appendix G contains a Commissioning Issue Tracking Log.

DP-5. **Write Basis of Design:** The Basis of Design is a stand-alone document that records the concepts, calculations, decisions, and product selections used to meet the Project Requirements. It should be prepared during the Schematic Design sub-phase, and then updated when other information is available, or at design review milestones, minimum.

DP-6. **Review Basis of Design:** Review the Basis of Design document to verify that the solutions described will meet the Project Requirements. Review the Basis of Design at each Design Review milestone.

(1) **DP-7. NOT USED**

DP-8. **DD Design Review:** Review design document submittals at the conclusion of the DD phase. Record review comments on Review Comment Resolution Forms. See Appendix H for a Design Review Comment Resolution Form.

Resolve review comments before proceeding with the next sub-phase of design.

Design review starts with comparing the design submittal with the schedule of deliverables. See Appendix E for a sample schedule of Design Deliverables by Phase. If the submittal is incomplete, return it to the designer without further review.
If the submittal appears to be complete, then proceed to a review with four tasks using statistical sampling methods to review for:

1. Legibility and consistency,
2. Coordination between disciplines,
3. Discipline-specific review for achieving the Project Requirements, and

**DP-9. CD Design Review:** Conduct a design review at the end of the CD phase as described in DP-8 above.

**DP-10. Update Systems Manual:** Add new materials to the Manual as they become available.

**DP-11. Validate Systems Manual:** Review the contents of the Systems Manual to verify that the contents meet the Project Requirements regarding level of completion and quality of work.

**DP-12. Write Commissioning Specifications:** The commissioning specifications convey the contractor’s responsibilities for work in support of the Commissioning Process. See the discussion of the specifications under the Documentation section.

Develop outline-level commissioning specifications during the Design Development sub-phase. The purpose of the outline commissioning specification is to promote coordination with other sections of the specification to avoid redundancy and omissions. Outline specifications list the systems and equipment that will be tested, and to the extent possible, the functions to be tested for each.

Complete the bid commissioning specifications early in the Contract Documents sub-phase. When complete, commissioning specifications define administrative requirements for commissioning as well as the technical requirements. Technical requirements include draft construction checklists and draft commissioning test procedures and data forms.

**DP-13. Write Draft Construction Checklists:** Draft construction checklists are a component of the bid commissioning specifications. Construction checklists identify quality of work expectations for use by the contractor in their quality control program. The checklists developed during Design are draft procedures that must be updated during Construction to reflect the approved equipment-specific requirements. See the discussion of the construction checklists under the Documentation section.

**DP-14. Write Draft Commissioning Tests:** Draft commissioning test procedures and data forms identify the prerequisites, participants, test equipment, test setup,
step-by-step test instructions and forms to record test data. Commissioning test procedures and data forms developed during Design are draft procedures that must be updated during Construction to reflect the approved equipment-specific requirements. See the discussion of the commissioning test procedures and data forms under the Documentation section.

**DP-15. Define Training Requirements**: Operations and maintenance staff and occupants/users may need training. General training requirements should be addressed in the Project Requirements document. However, it is still necessary to define the specific requirements for each system. To the extent that the contractor is responsible for training, the training requirements should be called out in the bid documents. Training by the design professional may also be appropriate. If so, training services should be included in the design professional’s agreement with the owner.

Include maintenance and operations staff and occupants in training as appropriate. The training program reflects the specific needs of the trainees. Occupant training for an office building would be far simpler than for a laboratory facility with variable air volume fume hood controls. Operators who have worked with a particular control vendor’s product for many years need less training than operators who will encounter a system for the first time.

**DP-16. Write Design Phase Commissioning Report**: At the conclusion of the Design phase, a brief commissioning report summarizes commissioning activities and issues. If all issues have been satisfactorily resolved, the report recommends acceptance of the Design phase work.

**DP-17. Design Phase Document Acceptance**: If the Design Commissioning Report recommends accepting the Design phase work, and if all other Design activities have been completed satisfactorily, the Design phase work should be accepted, with authorization to issue bid documents.

4. **Bid / Acquisition Phase**

**BP-1. Discuss Commissioning Requirements at Pre-bid Meeting**: If the project is being bid, inform bidders of the commissioning requirements. Many bidders have no experience with a formal commissioning process, and those that do may have experienced very different approaches. It is to everyone’s advantage to ensure that bidders are fully informed of their commissioning responsibilities.

**BP-2. Respond to Bidder Queries re Commissioning**: If questions about the commissioning specification arise during the bid period, respond promptly.

5. **Construction Phase**

**CP-1. Validate Proposed PR Changes**: Changes to Project Requirements made after the Predesign Phase pose a high risk to the success of the project. Late PR changes typically do not receive the same attention and are not subject to the same series of checks as those made during Predesign. The subtle ramifications of seemingly innocent PR changes are easy to overlook. Therefore, it is important to review carefully any proposed PR changes for their impact on the
operation of the facility or systems. PR changes should be approved by all stakeholders before being incorporated into the PR Document.

**CP-2. Update PR Document:** While the goal is to fully define and document Project Requirements during the Predesign Phase, changes may be necessary as the project progresses. When Project Requirements change or are defined further, update the PR Document. Review the PR Document for necessary changes at the beginning of the Construction Phase to reflect late Design Phase changes or addenda during the Bid period. Track changes to the PR Document using standard word processing software tracking tools. Insert notes to explain why changes were made.

**CP-3. Update Basis of Design:** Late changes to the PR document and bid period changes will likely generate changes to the Basis of Design. Fully document Basis of Design changes. Track changes to the Basis of Design document using standard word processing software tracking tools. Insert notes to explain why changes were made.

**CP-4. Validate Updated Basis of Design:** Review changes to the Basis of Design document as they occur to verify that changes are consistent with PR.

**CP-5. Update Commissioning Plan:** Revise the Commissioning Plan at the start of the Construction Phase. The revisions include addition of new Commissioning Team members, inclusion of the construction phase commissioning schedule as integrated with the master construction schedule, and specific communication and document handling protocols. Distribute the revised Commissioning Plan to all Commissioning Team members.

**CP-6. Update Systems Manual:** Add new materials to the Manual as they become available.

**CP-7. Verify Updated Systems Manual:** Review the contents of the Systems Manual to verify that the contents meet the Project Requirements regarding level of completion and quality of work.

**CP-8. Coordinate UT Staff Involvement in Commissioning:** Depending on how the commissioning duties are assigned for the project, UT staff will have varying levels of involvement, from attending training to witnessing tests. Establish clear lines of communication to ensure prompt notification of scheduled activities that require UT staff involvement.

**CP-9. Update Commissioning Team Membership:** Identify specific organizations and the individuals within those organizations who participate in the Commissioning Process. Establish and distribute to all Commissioning Team members a Commissioning Team roster with full contact information. Update and redistribute the roster when changes occur.

**CP-10. Conduct Pre-construction Commissioning Meeting:** Early in the Construction Phase, conduct a pre-construction meeting with the Commissioning Team. Distribute copies of the PR and Basis of Design documents, and review the contents. Review commissioning specification
provisions. Establish and document communication and document handling protocols.

**CP-11. Commissioning Review of Submittals:** Use statistical sampling methods to review the following submittals concurrently with the owner and designer review. Focus the review on the quality of the submittals and their ability to achieve the PR’s. Pay particular attention to substitutions and proposed deviations from the contract documents that could adversely affect performance or compliance with the PR’s.

1. Shop Drawings:
2. Product Data:
3. Preliminary Systems Manual:
4. Training Program & Trainers:

**CP-12. NOT USED**

**CP-13. NOT USED**

**CP-14. Finalize Commissioning Checklists:** Revise Commissioning Checklists to reflect reviewer comments and manufacturers’ recommendations in O&M manuals and installation and startup instructions.

**CP-15. Finalize Commissioning Test Procedures and Data Forms:** Revise Commissioning Test Procedures and Data Forms for the following tests to reflect reviewer comments and manufacturers’ recommendations in O&M manuals and installation and startup instructions. Mark the revised test procedures and data forms “Approved.”

1. Static tests:
2. Component tests:

**CP-16. NOT USED**

**CP-17. Periodic Site Visits:** Site visits evaluate the compliance of the installation with the PR document. Verify a sample of the installed work using the completed Commissioning Checklists. Proactive attention to consistent or systemic issues improves the quality of completed work and work that has not yet been completed. Observation of inconsistent issues (one or two occurrences of the same issue) improves the quality of completed work. Provide a site visit report that includes itemization of issues noted. Also, enter the issues on the Issues Log.

**CP-18. Fill Out Commissioning Checklists:** As work progresses, fill out Commissioning Checklists. The purpose is to focus the individual’s attention on quality issues that affect achievement of the PR’s. It is therefore important that the people that are doing the work have copies of the Checklists in the in possession while they work.

**CP-19. Verify Commissioning Checklists:** Verify the completed Commissioning Checklists during periodic site visits. Discrepancies between the completed
Checklists and observations indicate a failure of the quality control process that should be addressed.

**CP-20. Execute Commissioning Tests:** Use the Approved Commissioning Test Procedures and Data Forms to execute the tests. The Approved procedures are detailed instructions that must be followed precisely. Field modifications must receive approval before being used. Approved modifications must be clearly recorded on the procedures and data forms.

Record test results on the Data Forms immediately when they are observed to avoid errors. Record results, sign, and date the forms legibly in black ink. Preserve the original copies of the signed Data Forms as the primary record of the tests.

Stop the test if results do not meet specified acceptance criteria. Record the failure on the Data Form. Create a Commissioning Issue Report to initiate corrective action. When the Commissioning Issue Report is returned indicating that corrective action has been completed, repeat the test in its entirety, using a new Data Form.

For any system, execute tests starting with the simplest and progress to more complex tests in the following order:

1. Static tests
2. Component tests

**CP-21. Verify Test Data Reports:** Review test Data Forms for completeness, consistency, and compliance of reported results with specified acceptance criteria or other PR’s. Investigate results that are not acceptable, paying particular attention to patterns that indicate systemic problems. Specifications may require increasing the size of the validation sample of tests if the number of failures exceeds some limit.

**CP-22. Witness/Validate Commissioning Tests:** Use statistical methods to select a sample of completed tests to validate. The test technician repeats selected tests in the presence of a witness to demonstrate that the reported results are valid.

Witnesses must pay close attention to verify that the tests are conducted in strict accordance with the Approved Test Procedures. The witnesses must also directly observe the results of the tests to verify that the results recorded are accurate. The test technician and the witness sign and date the Data Form to validate the reported results.

Stop the test if results do not meet specified acceptance criteria. Record the failure on the Data Form. Create a Commissioning Issue Report to initiate corrective action. When the Commissioning Issue Report is returned indicating that corrective action has been completed, repeat the test in its entirety, using a
new Data Form. Specifications may require validating a larger sample of tests if the number of failures exceeds some limit.

CP-23. NOT USED

CP-24. Issues: Identify, Track, Resolve: Commissioning issues result from document reviews, checklists and tests. Record each issue using the Commissioning Issue Report Form or Submittal Review Comment Resolution Form (See Appendix F). Provide as much pertinent information as possible when completing the forms.

Track issue resolution using the Commissioning Issue Tracking Log (See Appendix G). Indicate receipt of satisfactory response to each issue when the respondents complete the Report or Comment Resolution forms. Indicate closure of the issue when resubmittals, observation, or retests indicate acceptable corrective action.

CP-25. NOT USED

CP-26. Incorporate New Equipment into O&M Program: Set up a formal procedure to enter new equipment information into the O&M database. Verify the completeness and accuracy of the entered information using statistical sampling.

CP-27. Construction Acceptance: When the contractor applies for the certificate of functional completion, review the status of submittals, commissioning tests and outstanding issues. If all of the following conditions have been met, then issue the Certificate of Functional Completion. The Certificate of Functional Completion is a prerequisite to Substantial Completion. Therefore, action on the contractor’s application must be timely.

(1) Submittals, including test Data Forms; complete and accepted,

(2) Tests, including retests; complete and documented,

(3) Issues; closed, and

(4) All other contractor commissioning requirements except deferred tests; complete.

CP-28. Construction Phase Commissioning Summary Report: Following issuance of the Certificate of Functional Completion, prepare the Construction Phase Commissioning Summary Report. The report describes the commissioning process, summarizes the functional condition of the systems based on results of the tests, and documents any PR’s that were not achieved.

6. Occupancy and Operations

OC-1. Submit Project to Warranty Team: Follow the University’s project warranty turnover procedure and submit the project to the warranty team.

OC-2. Deferred Testing: Deferred tests are tests that could not be performed during the construction phase for reasons beyond the contractor’s control.
Deferred tests should be clearly identified in the specifications when it is reasonable to be able to anticipate the need for deferral. The contractor should request deferred test status on other tests that were not identified as such in the specification.

Because deferred tests occur after the contractor turns the systems over to UT, the roles of the Commissioning Team members will be different than for construction phase tests. Typically, UT staff will operate the systems for deferred tests instead of the contractor. Contractors and designers should be invited to attend, but are not mandatory.

Tests may be deferred for several reasons:

1. Lack of design conditions after the systems were installed (air conditioner installed in January),
2. Lack of occupancy conditions (lack of plug loads needed for electrical distribution phase balance tests), or
3. Failure of owner-furnished, contractor-installed equipment to arrive on time. (Note that failure of the contractor’s supplier to deliver the correct material on time does not fall into this category.)

**OC-3. NOT USED**

**OC-4. Lessons-learned Workshop and Document:** After completion of the Construction Phase Commissioning Summary Report, convene a lessons-learned workshop to evaluate the Commissioning Process. Document the findings and distribute them to the appropriate UT organizations, the designers, the contractors and the Commissioning Authority.

**OC-5. NOT USED**

**OC-6. NOT USED**

**B. Schedule**

Project Manager: Fill in the schedules below to the best of your ability during Predesign. Adjust as necessary as the project proceeds.

1. **Predesign Phase Schedule**

The following Predesign Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP-1</td>
<td>Determine Cx Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-2</td>
<td>Adapt Model Cx Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-3</td>
<td>Define Scope of Cx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-4</td>
<td>Define Cx Team</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-5</td>
<td>Secure CxA (UT, consultant?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-6</td>
<td>Record &amp; Track Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-7</td>
<td>Define Project Requirements (PR) Issues</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. **Design Phase Schedule**
   The following Design Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP-1</td>
<td>Validate Proposed PR Changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-2</td>
<td>Update PR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-3</td>
<td>Update Cx Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-4</td>
<td>Record &amp; Track Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-5</td>
<td>Write Basis of Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-6</td>
<td>Review Basis of Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-8</td>
<td>Design Review @ DD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-9</td>
<td>Design Review @ CD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-10</td>
<td>Update Systems Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-11</td>
<td>Validate Systems Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-12</td>
<td>Write Cx Specifications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-13</td>
<td>Write Draft Construction Checklists</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-14</td>
<td>Write Draft Cx Tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-15</td>
<td>Define Training Requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-16</td>
<td>Write Design Phase Cx Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-17</td>
<td>Design Phase Document Acceptance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. **Bid / Acquisition Phase Schedule**
   The following Bid / Acquisition Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP-1</td>
<td>Discuss Cx Requirements at Pre-bid Mtg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP-2</td>
<td>Respond to Bidder Queries re Cx</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. **Construction Phase Schedule**
   The following Construction Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP-1</td>
<td>Validate Proposed PR Changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-2</td>
<td>Update PR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-3.</td>
<td>Update Basis of Design</td>
<td></td>
<td></td>
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<tr>
<td>-------</td>
<td>-------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-4.</td>
<td>Validate Updated Basis of Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-5.</td>
<td>Update Cx Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-6.</td>
<td>Update Systems Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-8.</td>
<td>Coordinate UT Staff Involvement in Cx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-9.</td>
<td>Finalize Cx Team Members</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-10.</td>
<td>Conduct Pre-construction Cx Meeting.</td>
<td></td>
<td></td>
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<tr>
<td>CP-11.</td>
<td>Cx Review of Submittals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-12.</td>
<td>Shop Drawings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-13.</td>
<td>Product Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-15.</td>
<td>Training Program &amp; Trainers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-16.</td>
<td>Finalize Cx Checklists</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-17.</td>
<td>Finalize Cx Test Procedures &amp; Data Forms.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-18.</td>
<td>Periodic Site Visits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-19.</td>
<td>Fill Out Cx Checklists</td>
<td></td>
<td></td>
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<tr>
<td>CP-20.</td>
<td>Verify Cx Checklists</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-21.</td>
<td>Execute Cx Tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-22.</td>
<td>Verify Test Data Reports.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-23.</td>
<td>Witness/Validate Cx Tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-24.</td>
<td>Issues: Identify, Track, Resolve</td>
<td></td>
<td></td>
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<tr>
<td>CP-25.</td>
<td>Incorporate New Equipment into O&amp;M Program</td>
<td></td>
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<tr>
<td>CP-26.</td>
<td>Construction Acceptance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-27.</td>
<td>Construction Phase Cx Summary Report</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. **Occupancy and Operations Phase Schedule**

The following Occupancy and Operations Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>OC-1.</td>
<td>Submit project to Warranty Team</td>
<td></td>
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</tr>
<tr>
<td>OC-2.</td>
<td>Deferred Testing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OC-3.</td>
<td>Lessons-learned Workshop &amp; Document</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IV **COMMISSIONING TEAM**

A. **Commissioning Team Membership**

1. **General**
   
   Complete the list of Commissioning Team members below with the names and organizations of the individuals who will be involved in the project.

2. **Owner**
a. Project Manager:
b. Commissioning Manager:
c. Physical Plant:
   (1) Architectural and Engineering Services:
   (2) Planning and Construction:
   (3) Building Maintenance:
   (4) Pickle Research Campus:
d. Occupants

3. Designer
   a. Architectural and Engineering Services:
   b. Planning and Construction:
   c. Contract A/E:

4. Constructor
   a. In-house:
      (1) Planning and Construction:
         (a) Project Manager (?):
   b. Contract:
      (1) General Contractor:
      (2) Subcontractor:
      (3) Subcontractor:
      (4) Subcontractor:

5. Commissioning Authority
   a. In-house:
   b. Contract:

B. Team Responsibilities

1. General
   The following list presents an overview of the commissioning responsibilities of each commissioning team member. Appendix J, “Commissioning Team Responsibilities,” is a table that presents a view that focuses on how the responsibilities for each commissioning activity are distributed among team members.

   a. Owner: As used here, the term “Owner” includes all UT entities; users, occupants, and Physical Plant. Physical Plant, through its several departments, provides project management and in some cases design and construction services.
(1) Project Manager (Physical Plant): The Project Manager plays a central role in the Commissioning Process. They initiate the Commissioning Process by determining the Commissioning Level, the scope of commissioning, and the commissioning budget. They procure, either from in-house resources or from contracted consultants, the services of the Commissioning Authority. They manage the work of the Commissioning Authority and provide the authority to support the Commissioning Authority’s recommendations.

(a) Determine Commissioning Level (PP-1) and adapt the Model Commissioning Plan (PP-2).
(b) Define scope of commissioning (PP-3) and commissioning team roster (PP-4).
(c) Assist CxM in procurement of Commissioning Authority services (PP-5).
(d) Identify issues to be addressed by the PR document (PP-7).
(e) Assist in soliciting input to performance criteria (PP-8).
(f) Lead review of lessons learned (PP-9).
(g) Establish commissioning budget (PP-10).
(h) Determine commissioning schedule expectations (PP-11).
(i) Review predesign document completion and compliance with PR (PP-13).
(j) Review predesign phase commissioning report (PP-14).
(k) Accept completion of Predesign work (PP-15).
(l) Act on CxA recommendations for proposed PR changes (DP-1).
(m) Review update of PR with accepted changes (DP-2).
(n) Review update of Commissioning Plan (DP-3).
(o) Review status of issues (DP-4).
(p) Review basis of design document (DP-6).
(q) Commissioning review of design documents at DD, and CD (DP-8, DP-9).
(r) Update systems manual (DP-10).
(s) Validate systems manual update (DP-11).
(t) Review commissioning specifications, draft construction checklists, and draft commissioning tests (DP-12, DP-13, DP-14).
(u) Review training requirements (DP-15).
(v) Review design phase commissioning report (DP-16).
(w) Accept completion of design phase work (DP-17).
(x) Discuss commissioning requirements at pre-bid meeting (BP-1).
(y) Review responses to bidder queries regarding commissioning (BP-2).
(z) Act on CxA recommendations for proposed PR changes (CP-1).
(aa) Review update of PR with accepted changes (CP-2).
(bb) Review updated basis of design document (CP-4).
(cc) Review update of Commissioning Plan (CP-5).
(dd) Review update of systems manual (CP-7).
(ee) Coordinate UT staff involvement in commissioning (CP-8).
(ff) Provide input to commissioning team roster (CP-9).
(gg) Attend pre-construction commissioning meeting (CP-10).
(hh) Review commissioning submittals (CP-11).
(ii) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(jj) Review commissioning issues (CP-24).
(kk) Issue certificate of functional completion (CP-27).
(ll) Lead review of construction phase commissioning report (CP-28).
(mm) Coordinate contractor callbacks (OC-1).
(nn) Attend lessons-learned workshop (OC-4).

(2) Building Maintenance (Physical Plant): Building Maintenance, however, does have a unique role in the Commissioning Process. As the operators and maintainers of facilities, they are long-term stakeholders in the success of the Commissioning Process. Consequently, Building Maintenance reviews the design, the Commissioning Authority’s work, and the contractor’s submittals, participates in site visits, witnesses tests, and are the recipients of training.

(a) Review determination of Commissioning Level (PP-1).
(b) Review scope of commissioning (PP-3) and commissioning team roster (PP-4).
(c) Review candidates for Commissioning Authority services (PP-5).
(d) Identify issues to be addressed by the PR document (PP-7).
(e) Provide input to determine performance criteria (PP-8).
(f) Review lessons learned (PP-9).
(g) Review commissioning schedule expectations (PP-11).
(h) Provide input to systems manual requirements (PP-12).
(i) Review predesign document completion and compliance with PR (PP-13).
(j) Review predesign phase commissioning report (PP-14).
(k) Review completion of Predesign work (PP-15).
(l) Review proposed PR changes (DP-1).
(m) Review update of PR with accepted changes (DP-2).
(n) Review status of issues (DP-4).
(o) Review basis of design document (DP-6).
(p) Commissioning review of design documents at DD, and CD (DP-8, DP-9).
(q) Validate systems manual update (DP-11).
(r) Review commissioning specifications, draft construction checklists, and draft commissioning tests (DP-12, DP-13, DP-14).
(s) Define training requirements (DP-15).
(t) Review design phase commissioning report (DP-16).
(u) Review recommendation to accept design phase work (DP-17).
(v) Review responses to bidder queries regarding commissioning (BP-2).
(w) Review proposed construction phase PR changes (CP-1) and review documentation of same (CP-2).
(x) Review updated basis of design document (CP-4).
(y) Review update of Commissioning Plan (CP-5).
(z) Lead review of update of systems manual (CP-7).
(aa) Handle requests for UT staff involvement in commissioning (CP-8).
(bb) Provide input to commissioning team roster (CP-9).
(cc) Attend pre-construction commissioning meeting (CP-10).
(dd) Review commissioning submittals (CP-11).
(ee) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(ff) Make periodic site visits (CP-17).
(gg) Review completed commissioning checklists (CP-19).
(hh) Review completed commissioning test data reports (CP-21).
(jj) Review commissioning issues (CP-24).
(kk) Incorporate new equipment into O&M program (CP-26).
(ll) Review request for certificate of functional completion (CP-27).
(mm) Review construction phase commissioning report (CP-28).
(nn) Coordinate contractor callbacks (OC-1).
(oo) Assist in performing deferred commissioning tests (OC-2).
(pp) Attend lessons-learned workshop (OC-4).

(3) Users and occupants: Users and occupants determine the need for a renovation project and define the Project Requirements. In some cases, they will also receive training in the use of the renovated facility.

(a) Identify issues to be addressed by the PR document (PP-7).
(b) Provide input to determine performance criteria (PP-8).
(c) Review lessons learned (PP-9).
(d) Review recommendation to accept predesign documents (PP-15).
(e) Review proposed design phase PR changes (DP-1) and review documentation of same (DP-2).
(f) Review design issues (DP-4).
(g) Review recommendation to accept design phase work (DP-17).
(h) Review proposed construction phase PR changes (CP-1) and review documentation of same (CP-2).
(i) Review construction phase commissioning report (CP-28).
(j) Attend lessons-learned workshop (OC-4).

(4) Commissioning Manager (CxM): The CxM is a UT staff member responsible for the overall renovation project commissioning program at UT.

The CxM provides technical assistance to Project Managers on commissioning issues, particularly during predesign. The CxM reviews the determination of Commissioning Level for the project, reviews the adaptation of the appropriate Model Commissioning Plan and assists in defining the project Commissioning Team. Because these activities may occur before the Commissioning Authority is available to the Project Manager, the CxM provides the continuity and expertise that the Commissioning Authority would otherwise provide.
The CxM is normally not the Commissioning Authority for the project. The CxM, however, does take the lead in securing the services of the Commissioning Authority.

The CxM tracks resolution of issues and reviews results of the end-of-warranty evaluation. The CxM uses this information to evaluate the commissioning process and identify areas requiring increased (or reduced) commissioning attention in the Model Commissioning Plans.

The CxM monitors application of the commissioning process to renovation projects, tracks costs, benefits and lessons learned, recommends changes to the UT commissioning process, and is an advocate for the program.

(a) Review determination of Commissioning Level (PP-1) and adaptation of the Model Commissioning Plan (PP-2).
(b) Review scope of commissioning (PP-3) and commissioning team roster (PP-4).
(c) Lead procurement of Commissioning Authority services (PP-5).
(d) Review identification of PR issues (PP-7).
(e) Assist in soliciting input to performance criteria (PP-8).
(f) Review lessons learned (PP-9).
(g) Review predesign document completion and compliance with PR (PP-13).
(h) Review predesign phase commissioning report (PP-14).
(i) Review commissioning specifications, draft construction checklists, and draft commissioning tests (DP-12, DP-13, DP-14)
(j) Review design phase commissioning report (DP-16).
(k) Monitor coordination of UT staff participation in commissioning (CP-8).
(l) Review commissioning team roster (CP-9).
(m) Attend pre-construction commissioning meeting (CP-10).
(n) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(o) Maintain database of issues (CP-24).
(p) Review construction phase commissioning report (CP-28).
(q) Attend lessons learned workshop (OC-4).

b. Commissioning Authority: Again, regardless of whether the Commissioning Authority is an in-house entity, or an outside consultant, their commissioning roles are similar. The Commissioning Authority provides UT with an unbiased evaluation of the functional quality of the renovation project. the Commissioning Authority scope of work includes:

(a) Assist the PM in defining scope of commissioning (PP-3) and commissioning team roster (PP-4).
(b) Record and track issues (PP-6).
(c) Facilitate discussion and record identification of issues to be 
addressed by the PR document (PP-7).
(d) Facilitate Project Requirements workshops to solicit input to 
performance criteria (PP-8).
(e) Review lessons learned (PP-9).
(f) Advise PM on establishing commissioning budget (PP-10).
(g) Determine commissioning schedule expectations (PP-11).
(h) Assemble systems manual (PP-12).
(i) Lead review of predesign document completion and compliance with 
PR (PP-13).
(j) Write predesign phase commissioning report (PP-14).
(k) Recommend acceptance of completion of Predesign work (PP-15).
(l) Validate proposed PR changes (DP-1).
(m) Update PR with accepted changes (DP-2).
(n) Update Commissioning Plan (DP-3).
(o) Record and track status of issues (DP-4).
(p) Review basis of design document (DP-6).
(q) Commissioning review of design documents at DD, and CD (DP-8, 
DP-9).
(r) Assemble update of systems manual (DP-10).
(s) Write commissioning specifications, draft construction checklists, and 
draft commissioning tests (DP-12, DP-13, DP-14).
(t) Document training verification requirements in specifications (DP-
15).
(u) Write design phase commissioning report (DP-16).
(v) Recommend acceptance of completion of design phase work (DP-17).
(w) Lead discussion of commissioning requirements at pre-bid meeting 
(BP-1).
(x) Lead response to bidder queries regarding commissioning (BP-2).
(y) Validate proposed PR changes (CP-1).
(z) Update PR with accepted changes (CP-2).
(aa) Lead review of updated basis of design document (CP-4).
(bb) Assemble update of systems manual (CP-6).
(cc) Lead coordination of UT staff involvement in commissioning (CP-8).
(dd) Create commissioning team roster (CP-9).
(ee) Conduct pre-construction commissioning meeting (CP-10).
(ff) Lead review of commissioning submittals (CP-11).
(gg) Finalize commissioning checklists and test procedures (CP-14, CP-
15).
 hh) Make periodic site visits (CP-17).
(ii) Lead review of completed commissioning checklists (CP-19).
(jj) Lead review of completed commissioning test data reports (CP-21).
(kk) Lead witnessing of performance of commissioning tests (CP-22).
(ll) Lead identification, tracking and resolution of commissioning issues 
(CP-24).
(mm) Lead review of request for certificate of functional completion (CP-27).
(nn) Write construction phase commissioning report (CP-28).
(oo) Lead coordination of contractor callbacks (OC-1).
(pp) Direct performance of deferred commissioning tests (OC-2).
(qq) Lead lessons-learned workshop and document results (OC-4).

c. Designer: Regardless of whether the design professional, i.e. the architect and engineering consultants, is an in-house entity, or an outside consultant, their commissioning roles are similar. In general the designer is tasked to:

(1) Architect:

(a) Identify issues to be addressed by the PR document (PP-7). (If available during this activity.)
(b) Review update of PR with accepted changes (DP-2).
(c) Review update of Commissioning Plan (DP-3).
(d) Respond to design issues (DP-4).
(e) Write basis of design document (DP-5).
(f) Respond to comments on basis of design document (DP-6).
(g) Respond to commissioning review of design documents at DD, and CD (DP-8, DP-9).
(h) Update systems manual (DP-10).
(i) Coordinate commissioning specifications, draft construction checklists, and draft commissioning tests with CxA (DP-12, DP-13, DP-14).
(j) Incorporate training requirements in specifications (DP-15).
(k) Review design phase commissioning report (DP-16).
(l) Discuss commissioning requirements at pre-bid meeting (BP-1).
(m) Handle responses to bidder queries regarding commissioning (BP-2).
(n) Review update of PR with accepted changes (CP-2).
(o) Lead update of basis of design document (CP-3).
(p) Respond to review of updated basis of design document (CP-4).
(q) Review update of Commissioning Plan (CP-5).
(r) Review update of systems manual (CP-7).
(s) Provide input to commissioning team roster (CP-9).
(t) Attend pre-construction commissioning meeting (CP-10).
(u) Handle submittal and review of commissioning submittals (CP-11).
(v) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(w) Review completed commissioning test data reports (CP-21).
(x) Review commissioning issues (CP-24).
(y) Review request for certificate of functional completion (CP-27).
(z) Review construction phase commissioning report (CP-28).
(aa) Attend performance of deferred commissioning tests (OC-2).
(bb) Attend lessons-learned workshop (OC-4).

(2) Consultants (Engineers):
(a) Identify issues to be addressed by the PR document (PP-7). (If available during this activity.)
(b) Review update of PR with accepted changes (DP-2).
(c) Review update of Commissioning Plan (DP-3).
(d) Respond to design issues (DP-4).
(e) Write basis of design document (DP-5).
(f) Respond to comments on basis of design document (DP-6).
(g) Respond to commissioning review of design documents at DD, and CD (DP-8, DP-9).
(h) Update systems manual (DP-10).
(i) Coordinate commissioning specifications, draft construction checklists, and draft commissioning tests with CxA (DP-12, DP-13, DP-14).
(j) Incorporate training requirements in specifications (DP-15).
(k) Review design phase commissioning report (DP-16).
(l) Discuss commissioning requirements at pre-bid meeting (BP-1).
(m) Respond to bidder queries regarding commissioning (BP-2).
(n) Review update of PR with accepted changes (CP-2).
(o) Update basis of design document (CP-3).
(p) Respond to review of updated basis of design document (CP-4).
(q) Review update of Commissioning Plan (CP-5).
(r) Review update of systems manual (CP-7).
(s) Provide input to commissioning team roster (CP-9).
(t) Attend pre-construction commissioning meeting (CP-10).
(u) Review commissioning submittals (CP-11).
(v) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(w) Review completed commissioning test data reports (CP-21).
(x) Review commissioning issues (CP-24).
(y) Review request for certificate of functional completion (CP-27).
(z) Review construction phase commissioning report (CP-28).
(aa) Attend performance of deferred commissioning tests (OC-2).
(bb) Attend lessons-learned workshop (OC-4).

d. Constructor: Regardless of whether the constructor, including subcontractors or in-house shops, is an in-house entity, or an outside contractor, their commissioning roles are similar. For Level 1 Commissioning projects the constructor designates someone to manage and coordinate the commissioning work, referred to as the “Commissioning Technician.”

(1) General Contractor (GC):

(a) Review update of PR with accepted changes (CP-2).
(b) Review updated basis of design document (CP-4).
(c) Review update of Commissioning Plan (CP-5).
(d) Submit materials for update of systems manual (CP-6).
(e) Submit input to commissioning team roster (CP-9).
(f) Attend pre-construction commissioning meeting (CP-10).
(g) Submit and respond to review of commissioning submittals (CP-11).
(h) Review draft commissioning checklists and test procedures (CP-14, CP-15).
(i) Submit completed commissioning checklists (CP-18).
(j) Submit completed commissioning test data reports (CP-20).
(k) Manage response to commissioning issues (CP-24).
(l) Submit request for certificate of functional completion (CP-27).
(m) Review construction phase commissioning report (CP-28).
(n) Attend performance of deferred commissioning tests (OC-2).
(o) Attend lessons-learned workshop (OC-4).

(2) Commissioning Technician (CxT): The CxT coordinates and manages commissioning work for the GC. For Level 2 projects, the CxT is optional. If the level of complexity is “medium” but extensive, or if scheduling and coordination are challenging, the CxT is a valuable asset to the smooth flow of the commissioning process.

   (a) Review update of PR with accepted changes (CP-2).
   (b) Review updated basis of design document (CP-4).
   (c) Review update of Commissioning Plan (CP-5).
   (d) Review materials for update of systems manual before GC submittal (CP-6).
   (e) Coordinate UT staff involvement in commissioning (CP-8).
   (f) Review contractor input to commissioning team roster (CP-9).
   (g) Attend pre-construction commissioning meeting (CP-10).
   (h) Assemble and submit commissioning submittals (CP-11).
   (i) Review final commissioning checklists and test procedures (CP-14, CP-15).
   (j) Review and submit completed commissioning checklists (CP-18).
   (k) Direct and manage performance of commissioning tests (CP-20).
   (l) Record and submit commissioning test data reports (CP-20).
   (m) Report, track, and direct response to commissioning issues (CP-24).
   (n) Prepare request for certificate of functional completion (CP-27).
   (o) Review construction phase commissioning report (CP-28).
   (p) Attend lessons-learned workshop (OC-4).

(3) Subcontractors: Actions listed below are performed by subcontractors to the GC. Therefore, all actions flow through the GC.

   (a) Review update of PR with accepted changes (CP-2).
   (b) Review updated basis of design document (CP-4).
   (c) Review update of Commissioning Plan (CP-5).
   (d) Submit materials for update of systems manual (CP-6).
   (e) Provide input to commissioning team roster (CP-9).
   (f) Attend pre-construction commissioning meeting (CP-10).
   (g) Prepare submittals and respond to review of commissioning submittals (CP-11).
(h) Review final commissioning checklists and test procedures (CP-14, CP-15).
(i) Complete commissioning checklists (CP-18).
(j) Review completed commissioning test data reports (CP-19).
(k) Perform commissioning tests (CP-20).
(l) Respond to commissioning issues (CP-24).
(m) Review construction phase commissioning report (CP-28).
(n) Attend performance of deferred commissioning tests (OC-2).
(o) Attend lessons-learned workshop (OC-4).

(4) Suppliers: Actions listed below are performed by suppliers to subcontractors or to the GC. Therefore, all actions flow through the subcontractors and the GC.

(a) Review update of PR with accepted changes (CP-2).
(b) Review updated basis of design document (CP-4).
(c) Review update of Commissioning Plan (CP-5).
(d) Submit materials to contractor for update of systems manual (CP-6).
(e) Provide input to commissioning team roster (CP-9).
(f) Prepare submittals and respond to review of commissioning submittals (CP-11).
(g) Review final commissioning checklists and test procedures (CP-14, CP-15).
(h) Perform commissioning tests (CP-20).
(i) Attend performance of deferred commissioning tests (OC-2).
(j) Attend lessons-learned workshop (OC-4).

C. Team Communication

1. Formal
   Formal communications convey changes in scope, schedule, and/or price. Formal commissioning communications follow established contract lines: direction to make changes can only be made by the entity that holds the contract. Since the Commissioning Authority is under contract to the UT project manager (or is a staff member working under the project manager’s direction), the Commissioning Authority cannot and must not direct changes to the work of the design professional nor to the work of the constructor. The Commissioning Authority must only make recommendations to the project manager regarding changes they believe are necessary.

2. Informal
   While formal communications protocol is essential in matters of scope, schedule, and price, there are numerous other topics that do not require the cumbersome chain of command. Informal communications between the Commissioning Authority and the design engineer or a subcontractor can expedite solutions to issues and make coordination easier, provided the design prime (architect) or the general contractor will allow their subs to participate. Frequently informal communication quickly establishes a mutually acceptable solution to a difficult issue, which is then translated into a change of work through formal channels.
V  **Scope of Commissioning**
Two primary elements of the scope of commissioning are the list of “equipment and systems,” and the list of “functions and features” associated with each piece of equipment of system.

A. **Equipment & Systems**
The following equipment and systems are included in the scope of the Commissioning Process for this project. The Preface contains guidance on ranking equipment and systems. List here the highest ranked systems and equipment. The headings are suggestions and should be edited to suit the project.

B. **Functions and Features**
For each piece of equipment or system included in the scope of commissioning, determine which functions and features should be evaluated by the Commissioning Process. Functions and features selected for inclusion in the scope of commissioning for each item of equipment and systems are listed in parenthesis following the item in the list below.

1. **General Construction**
   a. Automatic Shading (response to movement of the sun, reduction of solar gain)
   b.
   c.

2. **Mechanical Systems**
   a.
   b.

3. **Electrical Systems**
   a. New Elevator Controls (response to call, response to send, firefighter override, response to fire alarm, response to loss of normal power)
   b.

VI  **Documentation**

A. **General**
The preceding text refers to a number of commissioning-related documents. The following is a brief discussion of the characteristics of the commissioning-related documents.

1. **Project Requirements**
A document that details the functional requirements of a project and the expectations of its use and operation. Included are project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

2. **Commissioning Plan**
A document that summarizes the scope of commissioning, organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.
3. **Systems Manual**  
A document that includes the operations manual, the maintenance manual and additional information of use to the owner and operators throughout the life of the facility. It contains the traditional O&M manual materials plus the documentation generated by the Commissioning Process, organized in a systems-oriented manner to make it useful for quick reference.

4. **Basis of Design**  
A document that records the concepts, calculations, decisions and rationales for those decisions, and product selections used to meet the Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The Basis of Design includes narrative descriptions and lists of individual items that support the design process.

5. **Commissioning Specifications**  
The portion of the bid documents that describes the contractor’s duties and responsibilities in support of the Commissioning Process. The commissioning specifications include draft Construction Checklists and draft Test Procedures.

   a. Construction Checklists are checklists of installation quality and operational integrity used to verify that the Project Requirements are being achieved.

   b. Test Procedures are the detailed instructions for conducting commissioning tests.

      1) Static tests: Most static tests are already included in standard specifications. They should be consolidated and managed under the commissioning process. Common static tests include pipe and duct leak tests, and cable insulation integrity tests.

      2) Component tests: Components are simple assemblies that are usually input or output devices in control systems, such as sensors, actuators, switches and relays. Verification of component functions is essential to the success of equipment and system functions. The intensity of the test procedures depends on the function of the component. For example, a temperature sensor in a process chilled water system might be calibrated at three temperatures, while a room temperature sensor might only be checked at a single temperature.

A document that summarizes the activities and results of the Commissioning Process, and recommends subsequent action.

7. **Lessons Learned Document**  
A document of the results of the lessons learned workshop.

8. **Issues Log**  
A formal, continuously updated record of problems and concerns, and their resolution, as identified by Commissioning Team members throughout the Commissioning Process.
Note: This document contains “hidden text,” which should be displayed in BLUE. If you do not see blue text in this document, it can be turned on in MS Word by pulling down the Tools menu and selecting Options. In the Options window, select the View tab. Under Nonprinting characters select the Hidden text option. Then click OK.

Hidden text is set NOT to print. However, if it does print, go to the Tools/Options window. On the Print tab under Include with document, turn off the Hidden text selection.
Commissioning Plan Level 3

I. INTRODUCTION

A. Purpose of this Model Commissioning Plan
   1. This Commissioning Plan describes the Level 3 commissioning process for [project name]. It describes the organization, responsibilities, and documentation of the Commissioning Process.

   - This “Model” Commissioning Plan for the Level 3 commissioning process is the framework for development of the “Project” Commissioning Plan. By turning off viewing of the hidden text in this document, and replacing bracketed fields […] with project-specific information, the remaining text is the first draft of the “Project” Commissioning Plan.

   - The “Model” Commissioning Plan describes the elements of the Commissioning Process in general terms applicable to projects assigned a Level 3 Commissioning Process status, without regard to the requirements of any specific project. The “Project” Commissioning Plan describes those project-specific requirements.

   2. This Commissioning Plan is a communication and planning tool. It is not a contract document. Responsibilities described must be incorporated in the contracts with the various Commissioning Team members.

B. Scope

   1. The Commissioning Plan describes the following elements of the Commissioning Process:

      - Commissioning Process from predesign through occupancy,
      - Commissioning team responsibilities during each phase of the project,
      - Scope of the commissioning process in terms of the equipment and systems to which the process applies, and in terms of the types of functions and features of interest for the included equipment and systems, and
      - Documentation requirements in each phase of the project.

Use of the Model Commissioning Plan

   - This Level 3 Model Commissioning Plan is part of a graded approach to the commissioning of renovation projects. It applies to projects assigned to the Level 3 Commissioning Process.

   - This is a “Model” Commissioning Plan for renovation projects. It is a template that outlines a generic Level 3 Commissioning Process. Use this Model Commissioning Plan
to generate project-specific Commissioning Plans for projects assigned to the Level 3 Commissioning Process.

- Use the companion “Model” Commissioning Plans for Level 1, Level 2 and Level 4 Commissioning Process projects.
- This “Model” Commissioning Plan should be reviewed and updated periodically as UT gains experience with the application of the Commissioning Process to renovation projects.
- This “Model” Commissioning Plan is not intended for application to Capital Projects, which are larger, proceed at a different pace, and command more resources.

Background

- Physical Plant decided to apply the commissioning process to improve the quality of renovation projects as an element of the Renovation Project Delivery Enhancement Program (RPDEP). The Process Action Team (F-PAT) charged with developing Theme #6, Institutional Stewardship and Commissioning, developed this Model Commissioning Plan with the support of Casault Engineering.

C. Objectives of the Commissioning Process

- Clearly document Project Requirements.
- Improve delivery of renovation projects.
- Improve maintainability and service life.
- Optimize resource consumption.
- Minimize negative impacts on the campus, surrounding buildings, and existing systems.

D. Definition of Commissioning Process

1. A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its system and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s Project Requirements. (ASHRAE Guideline 0-2005)

II Quality Philosophy

A. Quality Control

1. The Commissioning Process, at all Levels, holds the owner, operator/maintainer, designer, contractor, manufacturer and installer fully accountable for the quality of their work. Each of these commissioning team members must manage and control the quality of their work continuously. Only the people doing the work can create quality.

B. Quality Assurance

1. The Commissioning Process evaluates the effectiveness of the management and control of quality by the people doing the work.
2. The Commissioning Process is not a substitute for quality control. Diligently resist attempts to subvert the quality assurance function of the Commissioning Process into a substitute for quality control. Any such tendency increases the cost of the Commissioning Process and reduces its effectiveness. When the people doing the work are not held accountable for the quality of their work, quality declines markedly.

3. When design firms working for a major university figured out that the university engineers’ reviews were extensive, the designers became lax in checking the quality of the work before submitting it for review. They knew that the university staff would identify their errors for them.

III  COMMISSIONING PROCESS

A. Commissioning Activities by Phase

1. This section of the Model Commissioning Plan is a description of commissioning tasks specific to the Level 3 Commissioning Process for this project. The Commissioning Team section of this Model Commissioning Plan describes the responsibilities for each of these tasks. Tasks are listed in approximately sequential order, with earliest tasks listed first.

2. Predesign Phase

PP-1. Determine Commissioning Level: To determine the appropriate commissioning level for a project, follow these three steps, in this order:

   (1) Evaluate risk as described in the Preface.

   (2) Evaluate complexity as described in the Preface.

   (3) Select the commissioning level based on the table below. Select the Commissioning Level corresponding to the highest rated factor. A very low risk/low complexity project would be Level 3, for example.

<table>
<thead>
<tr>
<th>High risk or high complexity</th>
<th>Commissioning Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium risk or medium complexity</td>
<td>Commissioning Level 2</td>
</tr>
<tr>
<td>Low risk or low complexity</td>
<td>Commissioning Level 3</td>
</tr>
<tr>
<td>Very low risk and very low complexity</td>
<td>Commissioning Level 4</td>
</tr>
</tbody>
</table>

See the Preface for a discussion of determining the appropriate Commissioning Level for a project.

The Commissioning Level for this Project is Level 3. If this project is not Level 3, then use the Model Commissioning Plan that corresponds to whichever Level is determined.

Risk: [High] [Medium] [Low] [Very Low]. Select the risk level for this project. Delete other levels. This Level 3 Commissioning Plan is not suitable for
High or Medium Risk projects.
Complexity: [High] [Medium] [Low] [Very Low]. Select the complexity level for this project. Delete other levels. This Level 3 Commissioning Plan is not suitable for High or Medium Complexity projects.

Record the Commissioning Level in the PR document and attach the Risk Evaluation Matrix and the Complexity Evaluation Matrix to this Commissioning Plan.

**PP-2. Adapt Model Commissioning Plan:** When the Commissioning Level has been assigned, use the corresponding Model Commissioning Plan as a guide to the commissioning process. Save a copy of the Model Commissioning Plan as the new [Project <project name>] Commissioning Plan. Edit the [Project] Commissioning Plan to reflect the specifics of the project to the extent possible at this point in the project. The edited document is the first draft of the [Project] Commissioning Plan.

**PP-3. Define Scope of Commissioning:** To the extent possible, define the scope of commissioning. There are two elements of the scope of commissioning. The first is a list of equipment and systems anticipated to be included in the project that should be commissioned. The second element is a list of functions or features of the selected equipment or systems that should be commissioned. At this point in the project, the list of equipment and systems can probably be anticipated with reasonable confidence. However, the functions and features element is probably best left until the Commissioning Authority is on board and the design develops. Use this information to edit the “Scope of Commissioning” section of the [Project] Commissioning Plan.

**PP-4. Define Commissioning Team:** Edit the Team Membership paragraph under the “Commissioning Team” section of the Model Commissioning Plan to reflect the actual organizations and individuals who will participate on the Commissioning Team. Some information may not be available until later.

Determining who will provide the services of the Commissioning Authority is a particularly urgent decision. The Commissioning Authority may either be an in-house resource or contracted PSP.

**PP-5. Secure Commissioning Authority:** Immediately after determining how the services of the Commissioning Authority will be acquired, initiate the process of getting them involved in the project. If an in-house resource is appropriate, notify the organization or individual promptly. If a contracted resource is needed, work with Business Services to expedite the selection and procurement of the commissioning professional. Delay of the procurement of the Commissioning Authority results in lost opportunities and higher commissioning costs.
PP-6. **Record and Track Issues:** As issues are identified, record them and track their status until each is satisfactorily resolved. Appendix F contains a Commissioning Issue Report Form.

PP-7. **Define Project Requirements (PR) Issues:** Convene a meeting/workshop of all stakeholders to identify which issues to include in the PR document. Make sure input is effectively elicited from all stakeholders. Record all issues in the PR document. To the extent possible get input on performance criteria also. See the discussion of the PR document under the “Documentation” section.

*Note: Incorporate development of the PR issues and the associated performance criteria with project programming. Project Requirements are essential elements of the project program.*

Workshop Format: The facilitator (typically the Commissioning Authority) elicits input from all project stakeholders. The following format has proven effective:

1. **Present open-ended questions, or broad concepts, to the group.** Questions should be sufficiently broad and open-ended to elicit a wide range of responses. All discussions and comments are treated as confidential, and are not to be repeated outside of the workshop.

2. **For each subject or question,** ask each participant to take three to five minutes to write down as many responses as they can.

3. **Record individual responses in a round-robin session,** asking each person in turn to share one of their responses. Do not allow discussion at this point, except as necessary for the facilitator to be able to record the response accurately. Record responses on something that all can read (flip charts, erasable boards, PC projector, etc.).

4. **Review and clarify all responses,** so everyone has a common understanding of each response. Combine similar responses.

5. **Ask participants to rank the responses on a scale of 1 to 5.**

6. **Determine a group ranking based on the combined individual responses.** Discuss the top ten or so responses to further clarify and gain any additional insight. As a group, decide how many of the responses should become project requirements. The top-ranked responses from each subject become the project requirements.

PP-8. **Prompt for PR Performance Criteria:** Beginning with the effort to define the PR issues, prompt stakeholders for performance criteria for each PR issue. Additional meetings and correspondence may be needed to complete the criteria. Some performance criteria require input from design specialists who are not yet involved in the project. Record performance criteria in the PR document.

*Note: The facilitator of the workshop should encourage participants to focus on defining the issues clearly and establishing measurable acceptance criteria. Avoid the tendency to drift into problem-solving discussions. Problem-solving is the design professional’s responsibility.*
PP-10. Establish Commissioning Budget: Past experience with similar projects is the best basis for estimating the commissioning budget. When suitable project experience is not available, use rules of thumb to estimate the commissioning budget, and solicit input from the Commissioning Authority. Record the commissioning budget in the PR document.

PP-11. Determine Commissioning Schedule Expectations: Include schedule expectations in the PR document. During Predesign, it is sufficient to state whether there is any reason to believe that the Commissioning Process may add any time either to the Design or Construction Phase schedule. Normally, the Commissioning Process should add no time to the schedule except perhaps a couple of days for final intersystem tests after the last finishes are complete. Record the commissioning schedule expectations in the PR document.

3. Design Phase
The Design Phase commences with the design team’s receipt of the notice to proceed and ends with the issuance of bidding documents.

For the purpose of Model Commissioning Plan, the Design Phase consists of three sub- phases: Schematic Design (SD), Design Development (DD), and Contract Documents (CD). In some projects, these sub-phases may blur or be combined, depending on project management needs. Adjust the terminology in this section accordingly.

DP-1. Validate Proposed PR Changes: Changes to Project Requirements made after the Predesign Phase pose a high risk to the success of the project. Late PR changes typically do not receive the same attention and are not subject to the same series of checks as those made during Predesign. The subtle ramifications of seemingly innocent PR changes are easy to overlook. Therefore, it is important to review carefully any proposed PR changes for their impact on the operation of the facility or systems. PR changes should be approved by all stakeholders before being incorporated into the PR Document.

DP-2. Update PR Document: While the goal is to fully define and document Project Requirements during the Predesign Phase, changes may be necessary as the project progresses. When Project Requirements change or are defined further, update the PR Document. Review the PR Document for necessary changes at the beginning and at the end of the Design Phase. Track changes to the PR Document using standard word processing software tracking tools. Insert notes to explain why changes were made.

DP-3. Update Commissioning Plan: Update the Project Commissioning Plan (this document) to reflect changes to the Commissioning Level, scope of
commissioning, and Commissioning Team membership. As noted in the Predesign Phase discussion of the scope of commissioning, systems and equipment may need updating, but functions and features will almost certainly need updating during the Design Phase.

**DP-4. Record and Track Issues:** Record issues when they are identified. Track their status until each is satisfactorily resolved. Appendix G contains a Commissioning Issue Tracking Log.

**DP-5. NOT USED**

**DP-6. NOT USED**

(1) **DP-7. NOT USED**

**DP-8. NOT USED**

**DP-9. CD Design Review:** Review design document submittals at the conclusion of the DD phase. Record review comments on Review Comment Resolution Forms. See Appendix H for a Design Review Comment Resolution Form.

Resolve review comments before proceeding with the next sub-phase of design.

Design review starts with comparing the design submittal with the schedule of deliverables. See Appendix E for a sample schedule of Design Deliverables by Phase. If the submittal is incomplete, return it to the designer without further review.

If the submittal appears to be complete, then proceed to a review with four tasks using statistical sampling methods to review for:

(1) Legibility and consistency,

(2) Coordination between disciplines,

(3) Discipline-specific review for achieving the Project Requirements, and

(4) Specification applicability and consistency with Project Requirements and Basis of Design.

**DP-10. NOT USED**

**DP-11. NOT USED**

**DP-12. NOT USED**

**DP-13. Write Draft Construction Checklists:** Draft construction checklists are a component of the bid commissioning specifications. Construction checklists identify quality of work expectations for use by the contractor in their quality control program. The checklists developed during Design are draft procedures that must be updated during Construction to reflect the approved equipment-specific requirements. See the discussion of the construction checklists under the Documentation section.
DP-14. NOT USED
DP-15. NOT USED
DP-16. NOT USED

DP-17. Design Phase Document Acceptance: If the Design Commissioning Report recommends accepting the Design phase work, and if all other Design activities have been completed satisfactorily, the Design phase work should be accepted, with authorization to issue bid documents.

Bid / Acquisition Phase

BP-1. NOT USED
BP-2. NOT USED

4. Construction Phase

CP-1. Validate Proposed PR Changes: Changes to Project Requirements made after the Predesign Phase pose a high risk to the success of the project. Late PR changes typically do not receive the same attention and are not subject to the same series of checks as those made during Predesign. The subtle ramifications of seemingly innocent PR changes are easy to overlook. Therefore, it is important to review carefully any proposed PR changes for their impact on the operation of the facility or systems. PR changes should be approved by all stakeholders before being incorporated into the PR Document.

CP-2. Update PR Document: While the goal is to fully define and document Project Requirements during the Predesign Phase, changes may be necessary as the project progresses. When Project Requirements change or are defined further, update the PR Document. Review the PR Document for necessary changes at the beginning of the Construction Phase to reflect late Design Phase changes or addenda during the Bid period. Track changes to the PR Document using standard word processing software tracking tools. Insert notes to explain why changes were made.

CP-3. NOT USED
CP-4. NOT USED

CP-5. Update Commissioning Plan: Revise the Commissioning Plan at the start of the Construction Phase. The revisions include addition of new Commissioning Team members, inclusion of the construction phase commissioning schedule as integrated with the master construction schedule, and specific communication and document handling protocols. Distribute the revised Commissioning Plan to all Commissioning Team members.

CP-6. NOT USED
CP-7. NOT USED

CP-8. Coordinate UT Staff Involvement in Commissioning: Depending on how the commissioning duties are assigned for the project, UT staff will have varying levels of involvement, from attending training to witnessing tests. Establish
clear lines of communication to ensure prompt notification of scheduled activities that require UT staff involvement.

**CP-9. Update Commissioning Team Membership:** Identify specific organizations and the individuals within those organizations who participate in the Commissioning Process. Establish and distribute to all Commissioning Team members a Commissioning Team roster with full contact information. Update and redistribute the roster when changes occur.

**CP-10. NOT USED**

**CP-11. Commissioning Review of Submittals:** Use statistical sampling methods to review the following submittals concurrently with the owner and designer review. Focus the review on the quality of the submittals and their ability to achieve the PR’s. Pay particular attention to substitutions and proposed deviations from the contract documents that could adversely affect performance or compliance with the PR’s.

1. Shop Drawings:

**CP-12. NOT USED**

**CP-13. NOT USED**

**CP-14. Finalize Commissioning Checklists:** Revise Commissioning Checklists to reflect reviewer comments and manufacturers’ recommendations in O&M manuals and installation and startup instructions.

**CP-15. NOT USED**

**CP-16. NOT USED**

**CP-17. Periodic Site Visits:** Site visits evaluate the compliance of the installation with the PR document. Verify a sample of the installed work using the completed Commissioning Checklists. Proactive attention to consistent or systemic issues improves the quality of completed work and work that has not yet been completed. Observation of inconsistent issues (one or two occurrences of the same issue) improves the quality of completed work. Provide a site visit report that includes itemization of issues noted. Also, enter the issues on the Issues Log.

**CP-18. Fill Out Commissioning Checklists:** As work progresses, fill out Commissioning Checklists. The purpose is to focus the individual’s attention on quality issues that affect achievement of the PR’s. It is therefore important that the people that are doing the work have copies of the Checklists in the in possession while they work.

**CP-19. Verify Commissioning Checklists:** Verify the completed Commissioning Checklists during periodic site visits. Discrepancies between the completed Checklists and observations indicate a failure of the quality control process that should be addressed.

**CP-20. NOT USED**
CP-21. NOT USED
CP-22. NOT USED
CP-23. NOT USED

CP-24. Issues: Identify, Track, Resolve: Commissioning issues result from document reviews, checklists and tests. Record each issue using the Commissioning Issue Report Form or Submittal Review Comment Resolution Form (See Appendix F). Provide as much pertinent information as possible when completing the forms.

Track issue resolution using the Commissioning Issue Tracking Log (See Appendix G). Indicate receipt of satisfactory response to each issue when the respondents complete the Report or Comment Resolution forms. Indicate closure of the issue when resubmittals, observation, or retests indicate acceptable corrective action.

CP-26. Incorporate New Equipment into O&M Program: Set up a formal procedure to enter new equipment information into the O&M database. Verify the completeness and accuracy of the entered information using statistical sampling.

CP-27. Construction Acceptance: When the contractor applies for the certificate of functional completion, review the status of submittals, commissioning tests and outstanding issues. If all of the following conditions have been met, then issue the Certificate of Functional Completion. The Certificate of Functional Completion is a prerequisite to Substantial Completion. Therefore, action on the contractor’s application must be timely.

1. Submittals, including test Data Forms; complete and accepted,
2. Tests, including retests; complete and documented,
3. Issues; closed, and
4. All other contractor commissioning requirements except deferred tests; complete.

CP-28. NOT USED

5. Occupancy and Operations

OC-1. Submit Project to Warranty Team: Follow the University’s project warranty turnover procedure and submit the project to the warranty team.

OC-2. NOT USED
OC-3. NOT USED
OC-4. NOT USED
OC-5. NOT USED
OC-6. NOT USED
B. Schedule

Project Manager: Fill in the schedules below to the best of your ability during Predesign. Adjust as necessary as the project proceeds.

1. Predesign Phase Schedule
The following Predesign Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP-1.</td>
<td>Determine Cx Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-2.</td>
<td>Adapt Model Cx Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-3.</td>
<td>Define Scope of Cx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-4.</td>
<td>Define Cx Team</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-5.</td>
<td>Secure CxA (UT, consultant?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-6.</td>
<td>Record &amp; Track Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-7.</td>
<td>Define Project Requirements (PR) Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-8.</td>
<td>Prompt for PR Performance Criteria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-10.</td>
<td>Establish Cx Budget</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-11.</td>
<td>Determine Cx Schedule Expectations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Design Phase Schedule
The following Design Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP-1.</td>
<td>Validate Proposed PR Changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-2.</td>
<td>Update PR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-3.</td>
<td>Update Cx Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-4.</td>
<td>Record &amp; Track Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-9.</td>
<td>Design Review @ CD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-13.</td>
<td>Write Draft Construction Checklists</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-17.</td>
<td>Design Phase Document Acceptance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Construction Phase Schedule
The following Construction Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP-1.</td>
<td>Validate Proposed PR Changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-2.</td>
<td>Update PR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-5.</td>
<td>Update Cx Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-8.</td>
<td>Coordinate UT Staff Involvement in Cx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-9.</td>
<td>Finalize Cx Team Members</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-11.</td>
<td>Cx Review of Submittals Shop Drawings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-14.</td>
<td>Finalize Cx Checklists</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-17.</td>
<td>Periodic Site Visits</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. **Occupancy and Operations Phase Schedule**

The following Occupancy and Operations Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>OC-1.</td>
<td>Submit project to Warranty Team</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IV **COMMISSIONING TEAM**

A. **Commissioning Team Membership**

1. **General**
   
   Complete the list of Commissioning Team members below with the names and organizations of the individuals who will be involved in the project.

2. **Owner**

   a. Project Manager:
   
   b. Commissioning Manager:
   
   c. Physical Plant:
      
      (1) Architectural and Engineering Services:
      
      (2) Planning and Construction:
      
      (3) Building Maintenance:
      
      (4) Pickle Research Campus:
   
   d. Occupants

3. **Designer**

   a. [Architectural and Engineering Services]:
   
   b. [Planning and Construction]:
   
   c. [Contract A/E]:

4. **Constructor**

   a. [In-house]:
      
      (1) Planning and Construction:
         
      (a) Project Manager (?):
   
   b. [Contract]:
5. Commissioning Authority
   a. [In-house]:
   b. [Contract]:

B. Team Responsibilities
   1. General

   The following list presents an overview of the commissioning responsibilities of each commissioning team member. Appendix J, “Commissioning Team Responsibilities,” is a table that presents a view that focuses on how the responsibilities for each commissioning activity are distributed among team members.

   a. Owner: As used here, the term “Owner” includes all UT entities; users, occupants, and Physical Plant. Physical Plant, through its several departments, provides project management and in some cases design and construction services.

   (1) Project Manager (Physical Plant): The Project Manager plays a central role in the Commissioning Process. They initiate the Commissioning Process by determining the Commissioning Level, the scope of commissioning, and the commissioning budget. They procure, either from in-house resources or from contracted consultants, the services of the Commissioning Authority. They manage the work of the Commissioning Authority and provide the authority to support the Commissioning Authority’s recommendations.

      (a) Determine Commissioning Level (PP-1) and adapt the Model Commissioning Plan (PP-2).
      (b) Define scope of commissioning (PP-3) and commissioning team roster (PP-4).
      (c) Assist CxM in procurement of Commissioning Authority services (PP-5).
      (d) Identify issues to be addressed by the PR document (PP-7).
      (e) Assist in soliciting input to performance criteria (PP-8).
      (f) Establish commissioning budget (PP-10).
      (g) Determine commissioning schedule expectations (PP-11).
      (h) Act on CxA recommendations for proposed PR changes (DP-1).
      (i) Review update of PR with accepted changes (DP-2).
      (j) Review update of Commissioning Plan (DP-3).
      (k) Review status of issues (DP-4).
      (l) Commissioning review of design documents at CD (DP-9).
      (m) Review draft construction checklists (DP-13).
      (n) Accept completion of design phase work (DP-17).
(o) Act on CxA recommendations for proposed PR changes (CP-1).
(p) Review update of PR with accepted changes (CP-2).
(q) Review update of Commissioning Plan (CP-5).
(r) Coordinate UT staff involvement in commissioning (CP-8).
(s) Provide input to commissioning team roster (CP-9).
(t) Review commissioning submittals (CP-11).
(u) Review draft commissioning checklists (CP-14).
(v) Review commissioning issues (CP-24).
(w) Issue certificate of functional completion (CP-27).
(x) Coordinate contractor callbacks (OC-1).

(2) Building Maintenance (Physical Plant): Building Maintenance, however, does have a unique role in the Commissioning Process. As the operators and maintainers of facilities, they are long-term stakeholders in the success of the Commissioning Process. Consequently, Building Maintenance reviews the design, the Commissioning Authority’s work, and the contractor’s submittals, participates in site visits, witnesses tests, and are the recipients of training.

(a) Review determination of Commissioning Level (PP-1).
(b) Review scope of commissioning (PP-3) and commissioning team roster (PP-4).
(c) Review candidates for Commissioning Authority services (PP-5).
(d) Identify issues to be addressed by the PR document (PP-7).
(e) Provide input to determine performance criteria (PP-8).
(f) Review commissioning schedule expectations (PP-11).
(g) Review proposed PR changes (DP-1).
(h) Review update of PR with accepted changes (DP-2).
(i) Review status of issues (DP-4).
(j) Commissioning review of design documents at CD (DP-9).
(k) Review draft construction checklists (DP-13).
(l) Review recommendation to accept design phase work (DP-17).
(m) Review proposed construction phase PR changes (CP-1) and review documentation of same (CP-2).
(n) Review update of Commissioning Plan (CP-5).
(o) Handle requests for UT staff involvement in commissioning (CP-8).
(p) Provide input to commissioning team roster (CP-9).
(q) Review commissioning submittals (CP-11).
(r) Review draft commissioning checklists (CP-14).
(s) Make periodic site visits (CP-17).
(t) Review completed commissioning checklists (CP-19).
(u) Review commissioning issues (CP-24).
(v) Incorporate new equipment into O&M program (CP-26).
(w) Review request for certificate of functional completion (CP-27).
(x) Coordinate contractor callbacks (OC-1).
(3) Users and occupants: Users and occupants determine the need for a renovation project and define the Project Requirements. In some cases, they will also receive training in the use of the renovated facility.

(a) Identify issues to be addressed by the PR document (PP-7).
(b) Provide input to determine performance criteria (PP-8).
(c) Review proposed design phase PR changes (DP-1) and review documentation of same (DP-2).
(d) Review design issues (DP-4).
(e) Review recommendation to accept design phase work (DP-17).
(f) Review proposed construction phase PR changes (CP-1) and review documentation of same (CP-2).

(4) Commissioning Manager (CxM): The CxM is a UT staff member responsible for the overall renovation project commissioning program at UT.

The CxM provides technical assistance to Project Managers on commissioning issues, particularly during predesign. The CxM reviews the determination of Commissioning Level for the project, reviews the adaptation of the appropriate Model Commissioning Plan and assists in defining the project Commissioning Team. Because these activities may occur before the Commissioning Authority is available to the Project Manager, the CxM provides the continuity and expertise that the Commissioning Authority would otherwise provide.

The CxM is normally not the Commissioning Authority for the project. The CxM, however, does take the lead in securing the services of the Commissioning Authority.

The CxM tracks resolution of issues to evaluate the commissioning process and identify areas requiring increased (or reduced) commissioning attention in the Model Commissioning Plans.

The CxM monitors application of the commissioning process to renovation projects, tracks costs, benefits and lessons learned, recommends changes to the UT commissioning process, and is an advocate for the program.

(a) Review determination of Commissioning Level (PP-1) and adaptation of the Model Commissioning Plan (PP-2).
(b) Review scope of commissioning (PP-3) and commissioning team roster (PP-4).
(c) Lead procurement of Commissioning Authority services (PP-5).
(d) Review identification of PR issues (PP-7).
(e) Assist in soliciting input to performance criteria (PP-8).
(f) Review draft construction checklists (DP-13)
(g) Monitor coordination of UT staff participation in commissioning (CP-8).
b. Commissioning Authority: Again, regardless of whether the Commissioning Authority is an in-house entity, or an outside consultant, their commissioning roles are similar. The Commissioning Authority provides UT with an unbiased evaluation of the functional quality of the renovation project. The Commissioning Authority scope of work includes:

(a) Assist the PM in defining scope of commissioning (PP-3) and commissioning team roster (PP-4).
(b) Record and track issues (PP-6).
(c) Facilitate discussion and record identification of issues to be addressed by the PR document (PP-7).
(d) Facilitate Project Requirements workshops to solicit input to performance criteria (PP-8).
(e) Advise PM on establishing commissioning budget (PP-10).
(f) Determine commissioning schedule expectations (PP-11).
(g) Validate proposed PR changes (DP-1).
(h) Update PR with accepted changes (DP-2).
(i) Update Commissioning Plan (DP-3).
(j) Record and track status of issues (DP-4).
(k) Commissioning review of design documents at CD (DP-9).
(l) Write draft construction checklists (DP-13).
(m) Recommend acceptance of completion of design phase work (DP-17).
(n) Validate proposed PR changes (CP-1).
(o) Update PR with accepted changes (CP-2).
(p) Lead coordination of UT staff involvement in commissioning (CP-8).
(q) Create commissioning team roster (CP-9).
(r) Lead review of commissioning submittals (CP-11).
(s) Finalize commissioning checklists (CP-14).
(t) Make periodic site visits (CP-17).
(u) Lead review of completed commissioning checklists (CP-19).
(v) Lead identification, tracking and resolution of commissioning issues (CP-24).
(w) Lead review of request for certificate of functional completion (CP-27).
(x) Lead coordination of contractor callbacks (OC-1).

Designer: Regardless of whether the design professional, i.e. the architect and engineering consultants, is an in-house entity, or an outside consultant, their commissioning roles are similar. In general the designer is tasked to:

(1) Architect:
   (a) Identify issues to be addressed by the PR document (PP-7). (If available during this activity.)
   (b) Review update of PR with accepted changes (DP-2).
(c) Review update of Commissioning Plan (DP-3).
(d) Respond to design issues (DP-4).
(e) Respond to commissioning review of design documents at CD (DP-9).
(f) Coordinate draft construction checklists with CxA (DP-13).
(g) Review update of PR with accepted changes (CP-2).
(h) Review update of Commissioning Plan (CP-5).
(i) Provide input to commissioning team roster (CP-9).
(j) Handle submittal and review of commissioning submittals (CP-11).
(k) Review draft commissioning checklists (CP-14).
(l) Review commissioning issues (CP-24).
(m) Review request for certificate of functional completion (CP-27).

(2) Consultants (Engineers):

(a) Identify issues to be addressed by the PR document (PP-7). (If available during this activity.)
(b) Review update of PR with accepted changes (DP-2).
(c) Review update of Commissioning Plan (DP-3).
(d) Respond to design issues (DP-4).
(e) Respond to commissioning review of design documents CD (DP-9).
(f) Coordinate draft construction checklists CxA (DP-13).
(g) Review update of PR with accepted changes (CP-2).
(h) Review update of Commissioning Plan (CP-5).
(i) Provide input to commissioning team roster (CP-9).
(j) Review commissioning submittals (CP-11).
(k) Review draft commissioning checklists (CP-14).
(l) Review commissioning issues (CP-24).
(m) Review request for certificate of functional completion (CP-27).

d. Constructor: Regardless of whether the constructor, including subcontractors or in-house shops, is an in-house entity, or an outside contractor, their commissioning roles are similar.

(1) General Contractor (GC):

(a) Review update of PR with accepted changes (CP-2).
(b) Review update of Commissioning Plan (CP-5).
(c) Submit input to commissioning team roster (CP-9).
(d) Submit and respond to review of commissioning submittals (CP-11).
(e) Review draft commissioning checklists (CP-14).
(f) Submit completed commissioning checklists (CP-18).
(g) Manage response to commissioning issues (CP-24).
(h) Submit request for certificate of functional completion (CP-27).

(2) Subcontractors: Actions listed below are performed by subcontractors to the GC. Therefore, all actions flow through the GC.

(a) Review update of PR with accepted changes (CP-2).
(b) Review updated basis of design document (CP-4).
(c) Review update of Commissioning Plan (CP-5).
(d) Submit materials for update of systems manual (CP-6).
(e) Provide input to commissioning team roster (CP-9).
(f) Attend pre-construction commissioning meeting (CP-10).
(g) Prepare submittals and respond to review of commissioning submittals (CP-11).
(h) Review final commissioning checklists and test procedures (CP-14, CP-15).
(i) Complete commissioning checklists (CP-18).
(j) Review completed commissioning test data reports (CP-19).
(k) Respond to commissioning issues (CP-24).
(l) Review construction phase commissioning report (CP-28).
(m) Attend performance of deferred commissioning tests (OC-2).
(n) Attend lessons-learned workshop (OC-4).

(3) Suppliers: Actions listed below are performed by suppliers to subcontractors or to the GC. Therefore, all actions flow through the subcontractors and the GC.

(a) Review update of PR with accepted changes (CP-2).
(b) Review update of Commissioning Plan (CP-5).
(c) Provide input to commissioning team roster (CP-9).
(d) Prepare submittals and respond to review of commissioning submittals (CP-11).
(e) Review final commissioning checklists (CP-14).

C. Team Communication

1. Formal
   Formal communications convey changes in scope, schedule, and/or price. Formal commissioning communications follow established contract lines: direction to make changes can only be made by the entity that holds the contract. Since the Commissioning Authority is under contract to the UT project manager (or is a staff member working under the project manager’s direction), the Commissioning Authority cannot and must not direct changes to the work of the design professional nor to the work of the constructor. The Commissioning Authority must only make recommendations to the project manager regarding changes they believe are necessary.

2. Informal
   While formal communications protocol is essential in matters of scope, schedule, and price, there are numerous other topics that do not require the cumbersome chain of command. Informal communications between the Commissioning Authority and the design engineer or a subcontractor can expedite solutions to issues and make coordination easier, provided the design prime (architect) or the general contractor will allow their subs to participate. Frequently informal communication quickly establishes a mutually acceptable solution to a difficult issue, which is then translated into a change of work through formal channels.
V  **SCOPE OF COMMISSIONING**
Two primary elements of the scope of commissioning are the list of “equipment and systems,” and the list of “functions and features” associated with each piece of equipment of system.

A.  **Equipment & Systems**
The following equipment and systems are included in the scope of the Commissioning Process for this project. The Preface contains guidance on ranking equipment and systems. List here the highest ranked systems and equipment. The headings are suggestions and should be edited to suit the project.

B.  **Functions and Features**
For each piece of equipment or system included in the scope of commissioning, determine which functions and features should be evaluated by the Commissioning Process. Functions and features selected for inclusion in the scope of commissioning for each item of equipment and systems are listed in parenthesis following the item in the list below.

1.  **General Construction**
   a.  Automatic Shading (response to movement of the sun, reduction of solar gain)

2.  **Mechanical Systems**
   a.

3.  **Electrical Systems**
   a.  New Elevator Controls (response to call, response to send, firefighter override, response to fire alarm, response to loss of normal power)

VI  **DOCUMENTATION**

A.  **General**
The preceding text refers to a number of commissioning-related documents. The following is a brief discussion of the characteristics of the commissioning-related documents.

1.  **Project Requirements**
   A document that details the functional requirements of a project and the expectations of its use and operation. Included are project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

2.  **Commissioning Plan**
   A document that summarizes the scope of commissioning, organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.
3. **Issues Log**
   A formal, continuously updated record of problems and concerns, and their resolution, as identified by Commissioning Team members throughout the Commissioning Process.
MODEL COMMISSIONING PLAN – LEVEL 4

Renovation Project Master Commissioning Plan

Note: This document contains “hidden text,” which should be displayed in BLUE. If you do not see blue text in this document, it can be turned on in MS Word by pulling down the Tools menu and selecting Options. In the Options window, select the View tab. Under Nonprinting characters select the Hidden text option. Then click OK.

Hidden text is set NOT to print. However, if it does print, go to the Tools/Options window. On the Print tab under Include with document, turn off the Hidden text selection.
University of Texas

Renovation [project name] Project Model Commissioning Plan

Commissioning Level 4

I INTRODUCTION

A. Purpose of this Model Commissioning Plan

1. This Commissioning Plan describes the Level 4 commissioning process for [project name]. It describes the organization, responsibilities, and documentation of the Commissioning Process.

   • This “Model” Commissioning Plan for the Level 4 commissioning process is the framework for development of the “Project” Commissioning Plan. By turning off viewing of the hidden text in this document, and replacing bracketed fields [...] with project-specific information, the remaining text is the first draft of the “Project” Commissioning Plan.

   • The “Model” Commissioning Plan describes the elements of the Commissioning Process in general terms applicable to projects assigned a Level 4 Commissioning Process status, without regard to the requirements of any specific project. The “Project” Commissioning Plan describes those project-specific requirements.

2. This Commissioning Plan is a communication and planning tool. It is not a contract document. Responsibilities described must be incorporated in the contracts with the various Commissioning Team members.

B. Scope

1. The Commissioning Plan describes the following elements of the Commissioning Process:

   • Commissioning Process from predesign through occupancy,

   • Commissioning team responsibilities during each phase of the project,

   • Scope of the commissioning process in terms of the equipment and systems to which the process applies, and in terms of the types of functions and features of interest for the included equipment and systems, and

   • Documentation requirements in each phase of the project.

Use of the Model Commissioning Plan

• This Level 4 Model Commissioning Plan is part of a graded approach to the commissioning of renovation projects. It applies to projects assigned to the Level 4 Commissioning Process.

• This is a “Model” Commissioning Plan for renovation projects. It is a template that outlines a generic Level 4 Commissioning Process. Use this Model Commissioning Plan
to generate project-specific Commissioning Plans for projects assigned to the Level 4 Commissioning Process.

- Use the companion “Model” Commissioning Plans for Level 1, Level 2 and Level 4 Commissioning Process projects.
- This “Model” Commissioning Plan should be reviewed and updated periodically as UT gains experience with the application of the Commissioning Process to renovation projects.
- This “Model” Commissioning Plan is not intended for application to Capital Projects, which are larger, proceed at a different pace, and command more resources.

**Background**

- Physical Plant decided to apply the commissioning process to improve the quality of renovation projects as an element of the Renovation Project Delivery Enhancement Program (RPDEP). The Process Action Team (F-PAT) charged with developing Theme #6, Institutional Stewardship and Commissioning, developed this Model Commissioning Plan with the support of Casault Engineering.

**C. Objectives of the Commissioning Process**

- Clearly document Project Requirements.
- Improve delivery of renovation projects.
- Improve maintainability and service life.
- Optimize resource consumption.
- Minimize negative impacts on the campus, surrounding buildings, and existing systems.

**D. Definition of Commissioning Process**

1. A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its system and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s Project Requirements. (ASHRAE Guideline 0-2005)

**II QUALITY PHILOSOPHY**

**A. Quality Control**

1. The Commissioning Process, at all Levels, holds the owner, operator/maintainer, designer, contractor, manufacturer and installer fully accountable for the quality of their work. Each of these commissioning team members must manage and control the quality of their work continuously. Only the people doing the work can create quality.

**B. Quality Assurance**

1. The Commissioning Process evaluates the effectiveness of the management and control of quality by the people doing the work.
2. The Commissioning Process is not a substitute for quality control. Diligently resist attempts to subvert the quality assurance function of the Commissioning Process into a substitute for quality control. Any such tendency increases the cost of the Commissioning Process and reduces its effectiveness. When the people doing the work are not held accountable for the quality of their work, quality declines markedly.

3. When design firms working for a major university figured out that the university engineers’ reviews were extensive, the designers became lax in checking the quality of the work before submitting it for review. They knew that the university staff would identify their errors for them.

III **COMMISSIONING PROCESS**

A. **Commissioning Activities by Phase**

1. This section of the Model Commissioning Plan is a description of commissioning tasks specific to the Level 4 Commissioning Process for this project. The Commissioning Team section of this Model Commissioning Plan describes the responsibilities for each of these tasks. Tasks are listed in approximately sequential order, with earliest tasks listed first.

2. **Predesign Phase**

   **PP-1. Determine Commissioning Level:** To determine the appropriate commissioning level for a project, follow these three steps, in this order:

   1. Evaluate risk as described in the Preface.
   2. Evaluate complexity as described in the Preface.
   3. Select the commissioning level based on the table below. Select the Commissioning Level corresponding to the highest rated factor. A very low risk/very low complexity project would be Level 4, for example.

      | High risk or high complexity | Commissioning Level 1 |
      | Medium risk or medium complexity | Commissioning Level 2 |
      | Low risk or low complexity | Commissioning Level 3 |
      | Very low risk and very low complexity | Commissioning Level 4 |

   See the Preface for a discussion of determining the appropriate Commissioning Level for a project.

   The Commissioning Level for this Project is Level 4. If this project is not Level 4, then use the Model Commissioning Plan that corresponds to whichever Level is determined.

   Risk: [High] [Medium] [Low] [Very Low]. Select the risk level for this
project. Delete other levels. This Level 4 Commissioning Plan is not suitable for High, Medium, or Low Risk projects.

Complexity: [High] [Medium] [Low] [Very Low]. Select the complexity level for this project. Delete other levels. This Level 4 Commissioning Plan is not suitable for High, Medium, or Low Complexity projects.

Record the Commissioning Level in the PR document and attach the Risk Evaluation Matrix and the Complexity Evaluation Matrix to this Commissioning Plan.

PP-2. Adapt Model Commissioning Plan: When the Commissioning Level has been assigned, use the corresponding Model Commissioning Plan as a guide to the commissioning process. Save a copy of the Model Commissioning Plan as the new [Project] <project name> Commissioning Plan. Edit the [Project] Commissioning Plan to reflect the specifics of the project to the extent possible at this point in the project. The edited document is the first draft of the [Project] Commissioning Plan.

PP-3. Define Scope of Commissioning: To the extent possible, define the scope of commissioning. There are two elements of the scope of commissioning. The first is a list of equipment and systems anticipated to be included in the project that should be commissioned. The second element is a list of functions or features of the selected equipment or systems that should be commissioned. At this point in the project, the list of equipment and systems can probably be anticipated with reasonable confidence. However, the functions and features element is probably best left until the Commissioning Authority is on board and the design develops. Use this information to edit the “Scope of Commissioning” section of the [Project] Commissioning Plan.

PP-4. Define Commissioning Team: Edit the Team Membership paragraph under the “Commissioning Team” section of the Model Commissioning Plan to reflect the actual organizations and individuals who will participate on the Commissioning Team. Some information may not be available until later.

Determining who will provide the services of the Commissioning Authority is a particularly urgent decision. The Commissioning Authority may either be an in-house resource or contracted PSP.

PP-5. NOT USED
PP-6. NOT USED
PP-7. NOT USED
PP-8. NOT USED
PP-9. NOT USED
PP-10. NOT USED
3. **Design Phase**
The Design Phase commences with the design team’s receipt of the notice to proceed and ends with the issuance of bidding documents.

For the purpose of Model Commissioning Plan, the Design Phase consists of three sub-phases: Schematic Design (SD), Design Development (DD), and Contract Documents (CD). In some projects, these sub-phases may blur or be combined, depending on project management needs. Adjust the terminology in this section accordingly.

**DP-1. Validate Proposed PR Changes:** Changes to Project Requirements made after the Predesign Phase pose a high risk to the success of the project. Late PR changes typically do not receive the same attention and are not subject to the same series of checks as those made during Predesign. The subtle ramifications of seemingly innocent PR changes are easy to overlook. Therefore, it is important to review carefully any proposed PR changes for their impact on the operation of the facility or systems. PR changes should be approved by all stakeholders before being incorporated into the PR Document.

**DP-2. Update PR Document:** While the goal is to fully define and document Project Requirements during the Predesign Phase, changes may be necessary as the project progresses. When Project Requirements change or are defined further, update the PR Document. Review the PR Document for necessary changes at the beginning and at the end of the Design Phase. Track changes to the PR Document using standard word processing software tracking tools. Insert notes to explain why changes were made.

**DP-3. NOT USED**
**DP-4. NOT USED**
**DP-5. NOT USED**
**DP-6. NOT USED**
**DP-7. NOT USED**
**DP-8. NOT USED**
**DP-9. NOT USED**
**DP-10. NOT USED**
**DP-11. NOT USED**
**DP-12. NOT USED**
Bid / Acquisition Phase

BP-1. NOT USED
BP-2. NOT USED

4. Construction Phase

CP-1. Validate Proposed PR Changes: Changes to Project Requirements made after the Predesign Phase pose a high risk to the success of the project. Late PR changes typically do not receive the same attention and are not subject to the same series of checks as those made during Predesign. The subtle ramifications of seemingly innocent PR changes are easy to overlook. Therefore, it is important to review carefully any proposed PR changes for their impact on the operation of the facility or systems. PR changes should be approved by all stakeholders before being incorporated into the PR Document.

CP-2. Update PR Document: While the goal is to fully define and document Project Requirements during the Predesign Phase, changes may be necessary as the project progresses. When Project Requirements change or are defined further, update the PR Document. Review the PR Document for necessary changes at the beginning of the Construction Phase to reflect late Design Phase changes or addenda during the Bid period. Track changes to the PR Document using standard word processing software tracking tools. Insert notes to explain why changes were made.

CP-3. NOT USED
CP-4. NOT USED
CP-5. NOT USED
CP-6. NOT USED
CP-7. NOT USED
CP-8. NOT USED
CP-9. NOT USED
CP-10. NOT USED
CP-11. NOT USED
CP-12. NOT USED
CP-13. NOT USED
CP-26. **Incorporate New Equipment into O&M Program:** Set up a formal procedure to enter new equipment information into the O&M database. Verify the completeness and accuracy of the entered information using statistical sampling.

CP-27. **Construction Acceptance:** When the contractor applies for the certificate of functional completion, review the status of submittals, commissioning tests and outstanding issues. If all of the following conditions have been met, then issue the Certificate of Functional Completion. The Certificate of Functional Completion is a prerequisite to Substantial Completion. Therefore, action on the contractor’s application must be timely.

1. Submittals, including test Data Forms; complete and accepted,
2. Tests, including retests; complete and documented,
3. Issues; closed, and
4. All other contractor commissioning requirements except deferred tests; complete.

CP-28. NOT USED

5. **Occupancy and Operations**

   OC-1. NOT USED
   OC-2. NOT USED
   OC-3. NOT USED
   OC-4. NOT USED
   OC-5. NOT USED
   OC-6. NOT USED
B. **Schedule**  
Project Manager: Fill in the schedules below to the best of your ability during Predesign. Adjust as necessary as the project proceeds.

1. **Predesign Phase Schedule**  
The following Predesign Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP-1</td>
<td>Determine Cx Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-2</td>
<td>Adapt Model Cx Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-3</td>
<td>Define Scope of Cx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-4</td>
<td>Define Cx Team</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-7</td>
<td>Define Project Requirements (PR) Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-8</td>
<td>Prompt for PR Performance Criteria</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. **Design Phase Schedule**  
The following Design Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP-1</td>
<td>Validate Proposed PR Changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-2</td>
<td>Update PR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. **Construction Phase Schedule**  
The following Construction Phase Commissioning Process milestones and dates are required to achieve effective commissioning of this project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Due Date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP-1</td>
<td>Validate Proposed PR Changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-2</td>
<td>Update PR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-26</td>
<td>Incorporate New Equipment into O&amp;M Program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP-27</td>
<td>Construction Acceptance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IV **COMMISSIONING TEAM**

A. **Commissioning Team Membership**

1. **General**  
Complete the list of Commissioning Team members below with the names and organizations of the individuals who will be involved in the project.

2. **Owner**
   a. Project Manager:
   b. Commissioning Manager:
   c. Physical Plant:
(1) Architectural and Engineering Services:
(2) Planning and Construction:
(3) Building Maintenance:
(4) Pickle Research Campus:

d. Occupants

3. Designer
   a. [Architectural and Engineering Services]:
   b. [Planning and Construction]:
   c. [Contract A/E]:

4. Constructor
   a. [In-house]:
      (1) Planning and Construction:
         (a) Project Manager (?):
   b. [Contract]:
      (1) General Contractor:
      (2) Subcontractor:
      (3) Subcontractor:
      (4) Subcontractor:

5. Commissioning Authority
   a. [In-house]:
   b. [Contract]:

B. Team Responsibilities

1. General
   The following list presents an overview of the commissioning responsibilities of each
   commissioning team member. Appendix J, “Commissioning Team Responsibilities,” is
   a table that presents a view that focuses on how the responsibilities for each
   commissioning activity are distributed among team members.

   a. Owner: As used here, the term “Owner” includes all UT entities; users, occupants, and Physical Plant. Physical Plant, through its several departments, provides project management and in some cases design and construction services.

   (1) Project Manager (Physical Plant): The Project Manager plays a central role in the Commissioning Process. They initiate the Commissioning Process by determining the Commissioning Level, the scope of commissioning, and the commissioning budget. They procure, either from in-house resources or from contracted consultants, the services of the Commissioning Authority.
They manage the work of the Commissioning Authority and provide the authority to support the Commissioning Authority’s recommendations.

(a) Determine Commissioning Level (PP-1) and adapt the Model Commissioning Plan (PP-2).
(b) Define scope of commissioning (PP-3) and commissioning team roster (PP-4).
(c) Identify issues to be addressed by the PR document (PP-7).
(d) Assist in soliciting input to performance criteria (PP-8).
(e) Act on CxA recommendations for proposed PR changes (DP-1).
(f) Review update of PR with accepted changes (DP-2).
(g) Act on CxA recommendations for proposed PR changes (CP-1).
(h) Review update of PR with accepted changes (CP-2).
(i) Issue certificate of functional completion (CP-27).

(2) Building Maintenance (Physical Plant): Building Maintenance, however, does have a unique role in the Commissioning Process. As the operators and maintainers of facilities, they are long-term stakeholders in the success of the Commissioning Process. Consequently, Building Maintenance reviews the design, the Commissioning Authority’s work, and the contractor’s submittals, participates in site visits, witnesses tests, and are the recipients of training.

(a) Review determination of Commissioning Level (PP-1).
(b) Review scope of commissioning (PP-3) and commissioning team roster (PP-4).
(c) Identify issues to be addressed by the PR document (PP-7).
(d) Provide input to determine performance criteria (PP-8).
(e) Review proposed PR changes (DP-1).
(f) Review update of PR with accepted changes (DP-2).
(g) Review proposed construction phase PR changes (CP-1) and review documentation of same (CP-2).
(h) Incorporate new equipment into O&M program (CP-26).
(i) Review request for certificate of functional completion (CP-27).

(3) Users and occupants: Users and occupants determine the need for a renovation project and define the Project Requirements. In some cases, they will also receive training in the use of the renovated facility.

(a) Identify issues to be addressed by the PR document (PP-7).
(b) Provide input to determine performance criteria (PP-8).
(c) Review proposed design phase PR changes (DP-1) and review documentation of same (DP-2).
(d) Review design issues (DP-4).
(e) Review recommendation to accept design phase work (DP-17).
(f) Review proposed construction phase PR changes (CP-1) and review documentation of same (CP-2).
(4) Commissioning Manager (CxM): The CxM is a UT staff member responsible for the overall renovation project commissioning program at UT.

The CxM provides technical assistance to Project Managers on commissioning issues, particularly during predesign. The CxM reviews the determination of Commissioning Level for the project, reviews the adaptation of the appropriate Model Commissioning Plan and assists in defining the project Commissioning Team. Because there will be no Commissioning Authority on this project, the CxM provides the continuity and expertise that the Commissioning Authority would otherwise provide.

The CxM monitors application of the commissioning process to renovation projects, tracks costs, benefits and lessons learned, recommends changes to the UT commissioning process, and is an advocate for the program.

(a) Review determination of Commissioning Level (PP-1) and adaptation of the Model Commissioning Plan (PP-2).
(b) Review scope of commissioning (PP-3) and commissioning team roster (PP-4).
(c) Review identification of PR issues (PP-7).
(d) Assist in soliciting input to performance criteria (PP-8).

b. Designer: Regardless of whether the design professional, i.e. the architect and engineering consultants, is an in-house entity, or an outside consultant, their commissioning roles are similar. In general the designer is tasked to:

(1) Architect:
(a) Identify issues to be addressed by the PR document (PP-7). (If available during this activity.)
(b) Review update of PR with accepted changes (DP-2).
(c) Review update of PR with accepted changes (CP-2).
(d) Review request for certificate of functional completion (CP-27).

(2) Consultants (Engineers):
(a) Identify issues to be addressed by the PR document (PP-7). (If available during this activity.)
(b) Review update of PR with accepted changes (DP-2).
(c) Review update of PR with accepted changes (CP-2).
(d) Review request for certificate of functional completion (CP-27).

c. Constructor: Regardless of whether the constructor, including subcontractors or in-house shops, is an in-house entity, or an outside contractor, their commissioning roles are similar.

(1) General Contractor (GC):
(a) Review update of PR with accepted changes (CP-2).
(b) Submit request for certificate of functional completion (CP-27).
(2) Subcontractors: Actions listed below are performed by subcontractors to the GC. Therefore, all actions flow through the GC.
   (a) Review update of PR with accepted changes (CP-2).

(3) Suppliers: Actions listed below are performed by suppliers to subcontractors or to the GC. Therefore, all actions flow through the subcontractors and the GC.
   (a) Review update of PR with accepted changes (CP-2).

V Scope of Commissioning
Two primary elements of the scope of commissioning are the list of “equipment and systems,” and the list of “functions and features” associated with each piece of equipment of system.

A. Equipment & Systems
The following equipment and systems are included in the scope of the Commissioning Process for this project. The Preface contains guidance on ranking equipment and systems. List here the highest ranked systems and equipment. The headings are suggestions and should be edited to suit the project.

B. Functions and Features
For each piece of equipment or system included in the scope of commissioning, determine which functions and features should be evaluated by the Commissioning Process. Functions and features selected for inclusion in the scope of commissioning for each item of equipment and systems are listed in parenthesis following the item in the list below.

1. General Construction
   a. Carpet (correct material, seams properly finished, stretched evenly)
   b.
   c.

2. Mechanical Systems
   a.
   b.

3. Electrical Systems
   a.
   b.

VI Documentation
A. General
The preceding text refers to a number of commissioning-related documents. The following is a brief discussion of the characteristics of the commissioning-related documents.
1. **Project Requirements**
   A document that details the functional requirements of a project and the expectations of its use and operation. Included are project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

2. **Commissioning Plan**
   A document that summarizes the scope of commissioning, organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.
APPENDIX A
COMMISSIONING LEVEL WORKSHEETS

Renovation Project Master Commissioning Plan

TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>APPENDIX #</th>
<th>APPENDIX TITLE</th>
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</thead>
<tbody>
<tr>
<td>A.1</td>
<td>Commissioning Level Table</td>
</tr>
<tr>
<td>A.2</td>
<td>Risk Evaluation Worksheet</td>
</tr>
<tr>
<td>A.3</td>
<td>Complexity Evaluation Worksheet</td>
</tr>
<tr>
<td>RISK</td>
<td>COMPLEXITY</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>High risk</td>
<td>OR</td>
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<tr>
<td>Medium risk</td>
<td>OR</td>
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<tr>
<td>Low risk</td>
<td>OR</td>
</tr>
<tr>
<td>Very low risk</td>
<td>AND</td>
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<tr>
<td></td>
<td>High complexity</td>
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<tr>
<td></td>
<td>Medium complexity</td>
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<td></td>
<td>Low complexity</td>
</tr>
<tr>
<td></td>
<td>Very low complexity</td>
</tr>
</tbody>
</table>

**Directions:** Select the Commissioning Level corresponding to the highest rating for Risk or Complexity. For example, a project with Low risk and Medium complexity normally would be assigned to Commissioning Level 2 due to the Medium complexity.

**Note:** To determine Risk and Complexity, refer to the Risk Evaluation Worksheet and the Complexity Evaluation Worksheet in this Appendix.
## Project Management & Construction

Texas, TX 78722

### APPENDIX A.2

#### RISK EVALUATION WORKSHEET

**Renovation Project Master Commissioning Plan**

---

**Project:**

**Your name:**

**Date:**

---

<table>
<thead>
<tr>
<th>Risk Factor ▼</th>
<th>Risk Level ▶</th>
<th>High</th>
<th>Med</th>
<th>Low</th>
<th>Very Low</th>
<th>Reason for Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission criticality of systems/facilities</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab, BSL-1, BSL-2, BSL-3</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Lab, Radiological</td>
<td>●</td>
<td></td>
<td></td>
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<tr>
<td>Lab, Chemical</td>
<td>●</td>
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<td></td>
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<td></td>
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<tr>
<td>Lab, health care</td>
<td>●</td>
<td></td>
<td></td>
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<tr>
<td>Emergency Services Support</td>
<td>●</td>
<td></td>
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<tr>
<td>Medical gas services</td>
<td>●</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Flammable gas services</td>
<td>●</td>
<td></td>
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<tr>
<td>Central plant</td>
<td>●</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Campus utility distribution</td>
<td>●</td>
<td></td>
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<tr>
<td>High visibility (political)</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Lab, Teaching</td>
<td>●</td>
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<tr>
<td>Lab gas services</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fast-track schedule</td>
<td>●</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Data or Comm Center</td>
<td>●</td>
<td></td>
<td></td>
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<tr>
<td>Central mech/elec systems within building</td>
<td>●</td>
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</tr>
<tr>
<td>Utility distribution within building</td>
<td>●</td>
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<tr>
<td>Roofing</td>
<td>●</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Classrooms</td>
<td>●</td>
<td></td>
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</tr>
<tr>
<td>Offices</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finishes and furnishings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Instructions:**

Use this worksheet to determine project Risk Level for use in the Commissioning Level Table. For each Risk Factor, a default value is indicated. Circle the cells corresponding to the Risk Level determined for this project for applicable Risk Factors. Indicate the reason for selecting a Risk Level different from the default value. Determine the highest level of risk indicated for the project. Use this Risk Level in the Commissioning Level Table.
### Appendix A.3
Complexity Evaluation Worksheet

Renovation Project Master Commissioning Plan

<table>
<thead>
<tr>
<th>System</th>
<th>Complexity Factor</th>
<th>Complexity Level</th>
<th>Reason for Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Envelope:</td>
<td>Changes that effect thermal or moisture performance</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Med</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Very Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Changes that effect finishes and furnishings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical Transport</td>
<td>Escalators, new, or revised controls</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Med</td>
<td></td>
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<td></td>
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<td>Low</td>
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<tr>
<td></td>
<td></td>
<td>Very Low</td>
<td></td>
</tr>
<tr>
<td>Plumbing</td>
<td>Replace fixtures, no change in fixture count</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Med</td>
<td></td>
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<td>Very Low</td>
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<tr>
<td></td>
<td>Revisions that change fixture count</td>
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<td></td>
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<td></td>
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<td>Very Low</td>
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<tr>
<td></td>
<td>Add electronic valve controls</td>
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<td></td>
<td></td>
<td>Med</td>
<td></td>
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<td>Low</td>
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<tr>
<td></td>
<td></td>
<td>Very Low</td>
<td></td>
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<tr>
<td></td>
<td>Revise central equipment (PRV, RPBP, pump, heater)</td>
<td>High</td>
<td></td>
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<td></td>
<td></td>
<td>Med</td>
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<td></td>
<td></td>
<td>Very Low</td>
<td></td>
</tr>
<tr>
<td>Fire Suppression</td>
<td>Water, relocate or add heads</td>
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<td></td>
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<td>Very Low</td>
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<td></td>
<td>Water, revise mains, risers, or FDC</td>
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<td></td>
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<td>Med</td>
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<td></td>
<td>Dry, revise mains, risers, or FDC</td>
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<td>Med</td>
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<td>Very Low</td>
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<td></td>
<td>Dry, revise compressed air equipment or controls</td>
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<td>Very Low</td>
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<td></td>
<td>Inert gas, relocate or add heads</td>
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<td></td>
<td></td>
<td>Med</td>
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<td>Very Low</td>
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<td></td>
<td>Inert gas, revise manifold or controls</td>
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<td>Med</td>
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<tr>
<td></td>
<td></td>
<td>Very Low</td>
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<tr>
<td></td>
<td>Inert gas, interface with other system</td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td>Med</td>
<td></td>
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<td></td>
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<td>Low</td>
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<tr>
<td></td>
<td></td>
<td>Very Low</td>
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<tr>
<td></td>
<td>Inert gas, protected enclosure modification</td>
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<td></td>
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<td>Med</td>
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<td>Low</td>
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<tr>
<td></td>
<td></td>
<td>Very Low</td>
<td></td>
</tr>
<tr>
<td>HVAC</td>
<td>Distribution, single or multiple-zones modification</td>
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<td></td>
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<td></td>
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<td>Med</td>
<td></td>
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<td></td>
<td></td>
<td>Low</td>
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<td></td>
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<td>Very Low</td>
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<tr>
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<td>Prime mover modification (air handler, fan, pump)</td>
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<tr>
<td></td>
<td></td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy conversion (chiller, boiler, heat exchanger)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Med</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interface with other systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HVAC Controls</td>
<td>Single or multiple points</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Med</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very Low</td>
<td></td>
</tr>
</tbody>
</table>
### Complexity Evaluation Worksheet

**Instructions:**
Use this worksheet to determine project Complexity Level for use in the Commissioning Level Table. For each Complexity Factor, a default value is indicated. Circle the cells corresponding to the Complexity Level determined for this project for applicable risk factors. Indicate the reason for selecting a Complexity Level different from the default value. Determine the highest level of complexity indicated for the project. Use this highest Complexity Level in the Commissioning Level Table.

<table>
<thead>
<tr>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity Factor</td>
</tr>
<tr>
<td>Single local controller or I/O module</td>
</tr>
<tr>
<td>System controller or multiple local controllers</td>
</tr>
<tr>
<td>Interface with other system</td>
</tr>
<tr>
<td><strong>Electrical (Power)</strong></td>
</tr>
<tr>
<td>Single or multiple-breaker modification</td>
</tr>
<tr>
<td>Circuit breaker panelboard modification</td>
</tr>
<tr>
<td>Distribution panel or switchboard modification</td>
</tr>
<tr>
<td><strong>Lighting Controls</strong></td>
</tr>
<tr>
<td>Programmable, single zone</td>
</tr>
<tr>
<td>Programmable, multiple zones</td>
</tr>
<tr>
<td>Programmable, control panel</td>
</tr>
<tr>
<td>Programmable, interface with other system</td>
</tr>
<tr>
<td><strong>Fire Alarm</strong></td>
</tr>
<tr>
<td>Single or multiple devices</td>
</tr>
<tr>
<td>Control panel</td>
</tr>
<tr>
<td>Interface with other system</td>
</tr>
<tr>
<td><strong>Telecomm</strong></td>
</tr>
<tr>
<td>Single or multiple outlets</td>
</tr>
<tr>
<td>New or revised switch</td>
</tr>
<tr>
<td><strong>Security/Access</strong></td>
</tr>
<tr>
<td>Single or multiple locations</td>
</tr>
<tr>
<td>Distributed controller</td>
</tr>
<tr>
<td>Interface with other system</td>
</tr>
</tbody>
</table>
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<table>
<thead>
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<th>APPENDIX #</th>
<th>APPENDIX TITLE</th>
</tr>
</thead>
<tbody>
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<td>Commissioning Authority Request for Qualifications</td>
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<td>B.2</td>
<td>Commissioning Authority Qualifications Screening Form</td>
</tr>
<tr>
<td>B.3</td>
<td>Commissioning Authority Interview Evaluation Form</td>
</tr>
<tr>
<td>B.4</td>
<td>Commissioning Authority Agreement</td>
</tr>
</tbody>
</table>
APPENDIX B.1
REQUEST FOR QUALIFICATIONS – COMMISSIONING AUTHORITY

Renovation Project Master Commissioning Plan

Explanatory Notes: The following is a model of an announcement to solicit qualifications submittals by parties interested in providing Commissioning Authority services. The announcement should be published in the customary media, but may also be posted to the Building Commissioning Association’s E-Forum newsgroup by sending email to mailto:bca-eforum@eGroups.com.

Submittals of qualifications for firms to serve as the Commissioning Authority to provide commissioning process services for renovation projects building commissioning services will be received by the University of Texas at Austin.

Definition: Building Commissioning: A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its system and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s Project Requirements. (ASHRAE Guideline 0-2005, The Commissioning Process)

The University of Texas at Austin will contract for commissioning process services for each project directly with selected firm(s). The university will select one or more firms for an on-call roster of commissioning process provider firms for a one-year period with the option to extend the contract up to a maximum of five years.

A set of standardized model commissioning plans tailored to varying levels of risk and complexity defines the UT Renovation Project Commissioning Process. The model commissioning plans may be downloaded from the UT Physical Plant website: http://www.utexas.edu/physicalplant/ae/index.html. Commissioning process services will be required during predesign, design, bidding, construction, and the first year of operation. The requirements of individual projects determine the need for commissioning process services, which may include, but are not limited to:

- Facilitating the definition of Project Requirements acceptance criteria,
- Coordinating UT staff involvement in the commissioning process,
- Developing and updating Commissioning Plans, including commissioning budget and schedule
• Reviewing Project Requirements document, Basis of Design, design drawings and specifications, control interface diagrams and one-line diagrams at several design phase milestones,
• Creating and updating the project systems manual,
• Recording, tracking, and assisting in resolution of commissioning issues,
• Commissioning reporting at several milestones, including recommendations regarding acceptance of the work,
• Preparing detailed commissioning specifications in collaboration with the designer of record,
• Preparing installation checklists and commissioning tests,
• Facilitating commissioning meetings, recording results, and preparing agendas,
• Reviewing specified contractor commissioning submittals, shop drawings and product submittals
• Verifying contractor installation checklists and commissioning tests using statistical sampling methods,
• Conducting end-of-warranty commissioning tests,
• Verifying staff training.

Projects to be commissioned are renovation projects in existing facilities. They are generally limited to construction costs of less than $2.0 million. They are characterized as being of medium to high complexity and pose a medium to high risk to the university. These projects may include offices, classrooms, auditoria, teaching and research laboratories, and other spaces. The scope of commissioning may include mechanical, electrical, plumbing, low voltage, telecommunications systems, active architectural features, and building envelope, etc. Design and construction periods may range from several months to two years.

Preferred qualifications include:
• Building Commissioning Association Certified Commissioning Professional, or equivalent,
• A minimum of three years of hands-on commissioning experience with the systems in the scope of commissioning identified above,
• Experience providing commissioning process services on projects of similar schedule, size, risk, and complexity,
• Demonstrated ability to work collaboratively with occupants, Physical Plant staff, design professionals, contractors,
• Experience that demonstrates understanding of conducting business in a public higher education environment,
• Experience providing commissioning services during the predesign and design phases,
• Clear understanding of contract relations and documents.
Interested and qualified firms are invited to submit a statement of qualifications consisting of the following:

1. History of the company;
2. Commissioning expertise and capability;
3. Local experience over the last three years on projects of similar size and scope, including contact information for individuals directly cognizant of the firm’s work;
4. Reference contacts with telephone numbers;
5. Resumes of key management personnel and their positions;
6. Qualifications of personnel to be assigned to UT projects, their certifications and proposed commissioning responsibilities;
7. Personnel rate schedule;
8. Location of the firm and proximity to the work site;
9. Professional liability insurance.

Submittals shall include three (3) copies each of a letter of interest, the above listed information, and completed SF 330 Form.

The University of Texas at Austin is an affirmative action/equal opportunity employer and encourages minority and women owned firms to participate.

The University will interview at least two firms from those responding to this solicitation. Firms invited for interview will be required to present comprehensive evidence of commissioning documents developed for a similar project commissioned by the firm. Final selection, in each case, will be based upon the qualifications listed above, in comparison to the needs of the projects, and the quality of the documents provided during the interview. Review documents will be returned to the applicant at the end of the interview. Firms selected for final consideration will be notified on or about ______________, 2006.

Send submittals to: University of Texas at Austin

Austin, TX
Attn: __________

Submittals must be received no later than 5:00 P.M. on ____________, 2006.
## APPENDIX B.2
COMMISSIONING AUTHORITY QUALIFICATIONS SCREENING FORM

Renovation Project Master Commissioning Plan

<table>
<thead>
<tr>
<th>QUALIFICATION ITEMS</th>
<th>RATING</th>
<th>FACTOR</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is building commissioning a principal business enterprise for the firm?</td>
<td>0 1 2 3 4 5</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Has the firm commissioned buildings of similar schedule, size, risk, and complexity as UT projects?</td>
<td>0 1 2 3 4 5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Does the proposed project manager have specific experience appropriate for the UT projects?</td>
<td>0 1 2 3 4 5</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Does the proposed commissioning team include the necessary skills for the UT projects?</td>
<td>0 1 2 3 4 5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Firm’s years of commissioning experience: (0 years = 0; 1-2 = 1; 3-5 = 3; 6-9 = 4; &gt;10 years = 5)</td>
<td>0 1 2 3 4 5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Firm’s experience providing commissioning process services in the public sector, and higher education.</td>
<td>0 1 2 3 4 5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Do the references include major consultants, contractors, and owners?</td>
<td>0 1 2 3 4 5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Proximity of firm to UT Austin.</td>
<td>0 1 2 3 4 5</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Multiply Qualification Item RATING by FACTOR to determine SCORE.

TOTAL SCORE:  

Subjective Comments:
## APPENDIX B.3
COMMISSIONING AUTHORITY INTERVIEW EVALUATION FORM

Renovation Project Master Commissioning Plan

<table>
<thead>
<tr>
<th>QUALIFICATION ITEMS</th>
<th>RATING</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Firm’s range of experience with commissioning activities.</strong></td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Evidence of successful commissioning of projects of similar schedule, size, risk, and complexity.</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Project manager’s experience with commissioning activities of similar complexity and sophistication.</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Team members’ experience with commissioning process activities in all phases of projects.</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Evidence of ability to develop comprehensive schedules, test procedures and check-off lists.</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Firm’s years of commissioning experience:</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td>(0 years = 0; 1-2 = 1; 3-5 = 3; 6-9 = 4; &gt;10 years = 5).</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Firm’s experience consistent with UT requirements.</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Evidence of experience working cooperatively with consultants and contractors.</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Evidence of familiarity with procedures required in public works environment.</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Evaluator’s subjective reaction to firm’s qualifications.</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Multiply Qualification Item RATING by FACTOR to determine SCORE.

**TOTAL SCORE:**
APPENDIX B.4
AGREEMENT BETWEEN
OWNER AND COMMISSIONING AUTHORITY
FOR
PROFESSIONAL SERVICES

Renovation Project Master Commissioning Plan

THIS IS AN AGREEMENT effective as of ________________

(‘Effective Date’)

between

__________________________

(“OWNER”)

and

__________________________

(“COMMISSIONING AUTHORITY”)

OWNER intends to for the design and construction of

__________________________

which is (all)(part of)

__________________________

(“Project”).

OWNER and COMMISSIONING AUTHORITY in consideration of their mutual covenants as set forth herein agree as follows:
ARTICLE 1--SERVICES OF COMMISSIONING AUTHORITY

1.01 Scope

A. COMMISSIONING AUTHORITY shall provide the Basic and Additional Services enumerated in Exhibit A

B. Upon this Agreement becoming effective, COMMISSIONING AUTHORITY is authorized to begin Basic Services as set forth in Exhibit A.

ARTICLE 2--OWNER’S RESPONSIBILITIES

2.01 General

A. OWNER shall have the responsibilities set forth herein.

ARTICLE 3--TIMES FOR RENDERING SERVICES

3.01 General

A. COMMISSIONING AUTHORITY’s services and compensation under this Agreement have been agreed to in anticipation of the orderly and continuous progress of the Project through completion. Unless specific periods of time or specific dates for providing services are specified in this Agreement, COMMISSIONING AUTHORITY’s obligation to render services hereunder will be for a period which may reasonably be required for the completion of said services.

B. If in this Agreement specific periods of time for rendering services are set forth or specific dates by which services are to be completed are provided, and if such periods of time or dates are changed through no fault of COMMISSIONING AUTHORITY, the rates and amounts of compensation provided for herein shall be subject to equitable adjustment. If OWNER authorizes or requests changes in the scope, extent or character of the Project, the time of performance of COMMISSIONING AUTHORITY’s services shall be adjusted equitably.

C. For purposes of this Agreement the term “day” means a calendar day of 24 hours.

D. If OWNER fails to give prompt written authorization to proceed with any phase of services after completion of the immediately preceding phase, or if COMMISSIONING AUTHORITY’s services are delayed or suspended through no fault of COMMISSIONING AUTHORITY, COMMISSIONING AUTHORITY shall be entitled to equitable adjustment of rates and amounts of compensation provided for elsewhere in this Agreement to reflect, among other things, reasonable costs incurred by COMMISSIONING AUTHORITY in connection with such delay or suspension and reactivation and the fact that the times of performance under this Agreement have been
ARTICLE 4--PAYMENTS TO COMMISSIONING AUTHORITY

4.01 Payment for Services and Reimbursable Expenses of COMMISSIONING AUTHORITY

A. For Basic and Additional Services. OWNER shall pay COMMISSIONING AUTHORITY for Basic and Additional Services performed or furnished under Exhibit A on the basis set forth in Exhibit C.

B. For Reimbursable Expenses. OWNER shall also pay COMMISSIONING AUTHORITY for Reimbursable Expenses related to Basic and Additional Services incurred by COMMISSIONING AUTHORITY and COMMISSIONING AUTHORITY’s Subconsultants as set forth in Exhibit C.

C. Adjustments

1. Except for any agreed lump sum, the compensation rates and sums stated in Exhibit C will be equitably adjusted annually on the date indicated in Exhibit C. or if no date is indicated, on the date when COMMISSIONING AUTHORITY customarily makes changes in COMMISSIONING AUTHORITY’s labor rates and other costs.

2. In the event of legislative actions after the date of this Agreement by any level of government that impose taxes or fees on COMMISSIONING AUTHORITY’s services or impose other costs in connection with the Project or compensation therefor, such new taxes, fees or costs shall be invoiced to and paid by the OWNER as a Reimbursable Expense to which a Factor of 1.0 shall be applied. Such sum shall be in addition to the COMMISSIONING AUTHORITY’s estimated total compensation.

4.02 Other Provisions Concerning Payments

A. Preparation of Invoices. Invoices will be prepared in accordance with COMMISSIONING AUTHORITY’s standard invoicing practices and calculated on the basis set forth in Exhibit C and be submitted to OWNER not more than once per month.

B. Payment of invoices. Invoices are due and payable within 30 days of receipt. If OWNER fails to pay payment due COMMISSIONING AUTHORITY for services and expenses within 30 days after receipt of COMMISSIONING AUTHORITY’s invoice therefor, the amounts due COMMISSIONING AUTHORITY will be increased at the rate of one percent per month (or the maximum rate of interest permitted by law, if less) from said thirtieth day. In addition, COMMISSIONING AUTHORITY may, after giving seven days written notice to OWNER, suspend services under this Agreement until
COMMISSIONING AUTHORITY has been paid in full all amounts due for services, expenses, and other related charges. Payments will be credited first to interest and then to principal.

C. Disputed Invoices. In the event of a disputed or contested invoice, only that portion so contested may be withheld from payment, and the undisputed portion will be paid.

D. Payments Upon Termination.

1. In the event of any termination under paragraph 6.06, COMMISSIONING AUTHORITY will be entitled to invoice OWNER and will be paid for all services performed or furnished and Reimbursable Expenses incurred through the effective date of termination.

2. In the event of termination by OWNER for convenience or by COMMISSIONING AUTHORITY for cause, COMMISSIONING AUTHORITY, in addition to invoicing for those items identified in paragraph 4.02.D. 1, shall be entitled to invoice OWNER and shall be paid a reasonable sum for services and expenses directly attributable to termination, including those provided and incurred both before and after the effective date of termination, such as reassignment of personnel, costs of terminating contracts with COMMISSIONING AUTHORITY’s Subconsultants and other related close-out costs, using methods and rates for Additional Services set forth in Exhibit C.

3. Records of COMMISSIONING AUTHORITY’s Costs. Records of COMMISSIONING AUTHORITY’s costs pertinent to COMMISSIONING AUTHORITY’s compensation under this Agreement shall be kept in accordance with generally accepted accounting practices. To the extent necessary to verify COMMISSIONING AUTHORITY’s charges and upon OWNER’s timely request, copies of such records will be made available to OWNER at cost.

ARTICLE 6--GENERAL CONSIDERATIONS

6.01 Standards of Performance

A. The standard of care for all professional and related services performed or furnished by COMMISSIONING AUTHORITY under this Agreement will be the care and skill ordinarily used by members of COMMISSIONING AUTHORITY’s profession practicing under similar circumstances at the same time and in the same locality. COMMISSIONING AUTHORITY makes no warranties, express or implied, under this Agreement or otherwise, in connection with COMMISSIONING AUTHORITY’S services.
B. COMMISSIONING AUTHORITY shall be responsible for the technical accuracy of its services and documents resulting therefrom, and OWNER shall not be responsible for discovering deficiencies therein. COMMISSIONING AUTHORITY shall correct such deficiencies without additional compensation except to the extent such action is directly attributable to deficiencies in OWNER-furnished information.

C. COMMISSIONING AUTHORITY shall not be responsible for deficiencies in professional services performed by or for design professionals engaged by the OWNER. COMMISSIONING AUTHORITY shall not be responsible for the acts or omissions of any Contractor or of any of their subcontractors, suppliers, or of any other individual or entity performing or furnishing any of the Work. COMMISSIONING AUTHORITY shall not be responsible for Contractor’s failure to perform or furnish the Work in accordance with the Contract Documents.

D. COMMISSIONING AUTHORITY may employ such Subconsultants as COMMISSIONING AUTHORITY deems necessary to assist in the performance or furnishing of the services. COMMISSIONING AUTHORITY shall not be required to employ any Subconsultant unacceptable to COMMISSIONING AUTHORITY.

E. This Agreement is based on requirements of applicable Laws or Regulations and OWNER-mandated standards applicable as of its Effective Date. Changes to these requirements after the Effective Date of this Agreement may be the basis for modifications to OWNER’s responsibilities or to the scope, schedule, and compensation for COMMISSIONING AUTHORITY’s services.

F. OWNER shall be responsible for, and COMMISSIONING AUTHORITY may rely upon, the accuracy and completeness of all requirements, programs, instructions, reports, data and other information furnished pursuant to this Agreement. COMMISSIONING AUTHORITY may use such requirements, reports, data and information in performing or furnishing services under this Agreement.

G. OWNER shall make decisions and carry out its other responsibilities in a timely manner so as not to delay the services of COMMISSIONING AUTHORITY and shall bear all costs incident thereto.

6.02 Authorized Project Representatives

A. Contemporaneous with the execution of this Agreement, COMMISSIONING AUTHORITY and OWNER shall designate specific individuals to act as their respective representatives with respect to the services to be performed or furnished by COMMISSIONING AUTHORITY and responsibilities of OWNER under this Agreement. Such individuals shall have authority to transmit instructions, receive information and render decisions relative to the Project on behalf of each respective party

6.03 Use of Documents
A. All Documents are instruments of service in respect to this Project and COMMISSIONING AUTHORITY shall retain an ownership and property interest therein (including the right of reuse at the discretion of the COMMISSIONING AUTHORITY) whether or not the Project is completed.

B. Copies of OWNER-furnished data that may be relied upon by COMMISSIONING AUTHORITY are limited to the printed copies (also known as hard copies) that are delivered to the COMMISSIONING AUTHORITY pursuant to Exhibit B. Files on electronic media of text, data, or graphics or of other types that are furnished by OWNER to COMMISSIONING AUTHORITY are only for convenience of COMMISSIONING AUTHORITY. Any conclusion or information obtained or derived from such electronic file will be at the users sole risk.

C. Copies of Documents that may be relied upon by OWNER are limited to the printed copies (also known as hard copies) that are signed or sealed by the COMMISSIONING AUTHORITY. Files on electronic media of text, data, or graphics or of other types that are furnished by COMMISSIONING AUTHORITY to OWNER are only for convenience of OWNER. If there is a discrepancy between the electronic files and hard copies, the hard copies will govern. Any conclusion or information obtained or derived from such electronic files will be at the users sole risk.

D. Because data stored on electronic media can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator

   1. The party receiving data in an electronic format agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the party delivering the data. COMMISSIONING AUTHORITY shall not be responsible to maintain data stored on electronic media after acceptance by OWNER.

   2. COMMISSIONING AUTHORITY reserves the right to remove all indicia of ownership or involvement, including title blocks and seals, from each electronic drawing.

E. Parties who create files on electronic media make no representations as to long term compatibility, usability, or readability of data resulting from the use of software application packages, operating systems, or computer hardware differing from those used by COMMISSIONING AUTHORITY at the start of the Project.

F. OWNER may make and retain copies of Documents for information and reference in connection with use on the Project by OWNER. Such Documents are not intended or represented to be suitable for reuse by OWNER or others on extensions of the Project or on any other project. Any such reuse or modification without written
verification or adaptation by COMMISSIONING AUTHORITY, as appropriate for the specific purpose intended, will be at OWNER’s sole risk and without liability or legal exposure to COMMISSIONING AUTHORITY, or to COMMISSIONING AUTHORITY’s officers, directors, partners, employees, or to COMMISSIONING AUTHORITY’s Subconsultants. OWNER shall indemnify and hold harmless COMMISSIONING AUTHORITY and COMMISSIONING AUTHORITY’s Subconsultants from all claims, costs, damages, losses, and expenses (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or resulting therefrom.

G. Any verification or adaptation of the Documents for extensions of the Project or for any other project will entitle COMMISSIONING AUTHORITY to further compensation at rates to be agreed upon by OWNER and COMMISSIONING AUTHORITY.

6.04 Insurance

A. COMMISSIONING AUTHORITY shall procure and maintain insurance as set forth in Exhibit E, "Insurance."

B. OWNER shall list COMMISSIONING AUTHORITY and COMMISSIONING AUTHORITY’s Subconsultants as additional insureds on any general liability or property insurance policies carried by OWNER which are applicable to the Project.

C. OWNER shall require Contractor to purchase and maintain general liability and other insurance as specified in the Contract Documents and to list COMMISSIONING AUTHORITY and COMMISSIONING AUTHORITY’s Subconsultants as additional insureds with respect to such liability and other insurance purchased and maintained by Contractor for the Project.

D. OWNER and COMMISSIONING AUTHORITY shall each deliver to the other certificates of insurance evidencing the coverages indicated in Exhibit F. Such certificates shall be furnished prior to commencement of COMMISSIONING AUTHORITY’s services and at renewal thereafter during the life of the Agreement.

E. All policies of property insurance shall contain provisions to the effect that COMMISSIONING AUTHORITY’s and COMMISSIONING AUTHORITY’s Subconsultants’ interests are covered and that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder.

F. At any time, OWNER may request that COMMISSIONING AUTHORITY, at OWNER’s sole expense, provide additional insurance coverage, different limits or revised deductibles in excess of those specified in Exhibit F. If so requested by OWNER,
and if commercially available, COMMISSIONING AUTHORITY shall obtain and shall require COMMISSIONING AUTHORITY’s Subconsultants to obtain such additional insurance coverage, differing limits, or revised deductibles, for such periods of time as requested by OWNER, at OWNER’s sole expense, and Exhibit F will be supplemented to incorporate these requirements.

6.05 Termination

A. The obligation to provide further services under this Agreement may be terminated:

1. For cause,

   a. By either party upon 30 days written notice in the event of substantial failure by the other party to perform in accordance with the terms hereof through no fault of the terminating party

   b. By COMMISSIONING AUTHORITY

      1) upon seven days written notice if COMMISSIONING AUTHORITY believes that COMMISSIONING AUTHORITY is being requested by OWNER to furnish or perform services contrary to COMMISSIONING AUTHORITY’s responsibilities as a licensed professional; or

      2) upon seven days written notice if the COMMISSIONING AUTHORITY’s services for the Project are delayed or suspended for more than ninety days for reasons beyond COMMISSIONING AUTHORITY’s control.

      3) in the case of termination under this paragraph, 605.A.I.b. COMMISSIONING AUTHORITY shall have no liability to OWNER on account of such termination.

   c. Notwithstanding the foregoing, this Agreement will not terminate as a result of such substantial failure if the party receiving such notice begins, within seven days of receipt of such notice, to correct its failure to perform and proceeds diligently to cure such failure within no more than thirty days of receipt thereof provided, however, that if and to the extent such substantial failure cannot be reasonably cured within such 30 day period, and if such party has diligently attempted to cure the same and thereafter continues diligently to cure the same, then the cure period provided for herein shall extend up to, but in no case more than, 60 days after the date of receipt of the notice.
2. For convenience, by OWNER effective upon the receipt of notice by COMMISSIONING AUTHORITY.

B. The terminating party under paragraphs 6.05.A.1 or 6.05.A.2 may set the effective date of termination at a time up to 30 days later than otherwise provided to allow COMMISSIONING AUTHORITY to complete tasks whose value would otherwise be lost, to prepare notes as to the status of completed and uncompleted tasks, and to assemble Project documents in orderly files.

6.06 Controlling Law

A. This Agreement is to be governed by the law of the state in which the Project is located.

6.07 Successors, Assigns, and Beneficiaries

A. OWNER and COMMISSIONING AUTHORITY each is hereby bound and the partners, successors, executors, administrators and legal representatives of OWNER and COMMISSIONING AUTHORITY (and to the extent permitted by paragraph 6.08.B the assigns of OWNER and COMMISSIONING AUTHORITY) are hereby bound to the other party to this Agreement and to the partners, successors, executors, administrators and legal representatives (and said assigns) of such other party, in respect of all covenants, agreements and obligations of this Agreement.

B. Neither OWNER nor COMMISSIONING AUTHORITY may assume, sublet or transfer any rights under or interest (including, but without limitation, moneys that are or may become due) in this Agreement without the written consent of the other, except to the extent that any assignment, subletting or transfer is mandated or restricted by law. Unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under this Agreement.

C. Unless expressly provided otherwise in this Agreement:

1. Nothing in this Agreement shall be construed to create, impose or give rise to any duty owed by OWNER or COMMISSIONING AUTHORITY to any Contractor, Contractor’s Subcontractor or Supplier, other individual or entity, or to any surety for or employee of any of them.

2. All duties and responsibilities undertaken pursuant to this Agreement will be for the sole and exclusive benefit of OWNER and COMMISSIONING AUTHORITY and not for the benefit of any other party.

6.08 Dispute Resolution
A. OWNER and COMMISSIONING AUTHORITY agree to negotiate all disputes between them in good faith for a period of 30 days from the date of notice prior to exercising their rights under Exhibit F or other provisions of this Agreement, or under law.

B. If and to the extent that OWNER and COMMISSIONING AUTHORITY have agreed on a method and procedure for resolving disputes between them arising out of or relating to this Agreement, such dispute resolution method and procedure, is set forth in Exhibit F, “Dispute Resolution.” In the absence of such an agreement, the parties may exercise their rights under law.

6.09 Hazardous Condition

A. OWNER acknowledges that COMMISSIONING AUTHORITY is performing professional services for OWNER and that COMMISSIONING AUTHORITY is not and shall not be required to become an “operator,” “generator,” or “transporter” of Hazardous Materials which are or may be encountered at or near the Site in connection with COMMISSIONING AUTHORITY’s activities under this Agreement.

B. OWNER represents that to the best of its knowledge a Hazardous Condition does not exist and it has disclosed to COMMISSIONING AUTHORITY the existence of all Hazardous Materials located at or near the Site, including type, quantity and location.

C. If any such Hazardous Condition is encountered or alleged, COMMISSIONING AUTHORITY shall have the obligation to notify OWNER and, to the extent of applicable Laws and Regulations, appropriate governmental officials.

D. It is acknowledged by both parties that the COMMISSIONING AUTHORITY’s scope of services does not include any services related to a Hazardous Condition. In the event COMMISSIONING AUTHORITY or any other party encounters a Hazardous Condition at the Site, or should it become known in any way that Hazardous Materials may be present at the Site or any adjacent areas in such a manner as to affect the performance of COMMISSIONING AUTHORITY’s services, COMMISSIONING AUTHORITY may, at its option and without liability for consequential or any other damages, suspend performance of services on the Project until OWNER: (i) retains appropriate specialist consultant(s) or contractor(s) to identify and, as appropriate, abate, remediate, or remove the Hazardous Condition, and (ii) warrants that the Site is in full compliance with applicable Laws and Regulations.

E. If the COMMISSIONING AUTHORITY’s services under this Agreement cannot be performed because of a Hazardous Condition, the existence of the condition shall justify COMMISSIONING AUTHORITY terminating this Agreement for cause on 30 days notice.

6.10 Allocation of Risks-- Indemnification
A. To the fullest extent permitted by law, COMMISSIONING AUTHORITY shall indemnify and hold harmless OWNER, OWNER’s officers, directors, partners, and employees from and against any and all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused solely by the negligent acts or omissions of COMMISSIONING AUTHORITY or COMMISSIONING AUTHORITY’s officers, directors, partners, employees, and COMMISSIONING AUTHORITY’s Subconsultants in the performance and furnishing of COMMISSIONING AUTHORITY’s services under this Agreement.

B. To the fullest extent permitted by law, OWNER shall indemnify and hold harmless COMMISSIONING AUTHORITY, COMMISSIONING AUTHORITY’s officers, directors, partners, and employees and COMMISSIONING AUTHORITY’s Subconsultants from and against any and all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused solely by the negligent acts or omissions of OWNER or OWNER’s officers, directors, partners, employees, and other consultants retained by OWNER with respect to this Agreement or the Project.

C. In addition to the indemnity provided under paragraph 6.10.B of this Agreement, and to the fullest extent permitted by law, OWNER shall indemnify and hold harmless COMMISSIONING AUTHORITY and its officers, directors, partners, employees, and COMMISSIONING AUTHORITY’s Subconsultants from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused by, arising out of or relating to or resulting from a Hazardous Condition at, on, or under the Site, provided that (i) any such claim, cost, loss or damage is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than completed Construction), including the loss of use resulting therefrom, and (ii) nothing in this paragraph shall obligate OWNER to indemnify any individual or entity from and against the consequences of that individual’s or entity’s own negligence or willful misconduct.

6.11 Notices

Any notice required under this Agreement will be in writing, addressed to the appropriate party at its address on the signature page and given personally, by certified mail (return receipt requested), by facsimile, or by a commercial courier service All notices shall be effective upon the date of receipt.

6.12 Survival

All express representations, indemnifications or limitations of liability made in or given in this
Agreement will survive its completion or termination for any reason.

6.13 Severability

Any provision or part of the Agreement held to be void or unenforceable under any law or regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon OWNER and COMMISSIONING AUTHORITY, who agree that the Agreement shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

6.14 Waiver

Non-enforcement Of any provision by either party shall not constitute a waiver of that provision nor shall it affect the enforceability of that provision or of the remainder of this Agreement.

6.15 Headings

The headings used in this Agreement are for general reference only and do not have special significance.

ARTICLE 7-- DEFINITIONS

7.01 Defined Terms

A. Wherever used in this Agreement (including the Exhibits hereto) and printed with initial or all capital letters the following terms have the meanings indicated which are applicable to both the singular and plural thereof

1. Building Commissioning--A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its system and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s Project Requirements. (ASHRAE Guideline 0-2005, The Commissioning Process)

2. Agreement--This “Standard Form of Agreement between OWNER and COMMISSIONING AUTHORITY for Professional Services” including those Exhibits listed in Article 8 thereof

3. Construction Agreement--The written agreement contained in the Contract Documents between OWNER and Contractor covering the Work to be performed or furnished with respect to this Project.

4. Construction--The performing or furnishing of labor, the furnishing and
incorporating of materials and equipment into various portions of the Work, and the furnishing of services (other than Design Professional Services) and documents, all as required by the Drawings and Specifications. Construction may be provided by Contractor or Subcontractors or Suppliers.

5. Documents--The documents, including data, reports, and other deliverables, whether in printed or electronic media format, provided or furnished in appropriate phases by COMMISSIONING AUTHORITY to OWNER pursuant to this Agreement.

6. Effective Date of the Agreement--The date indicated in this Agreement on which it becomes effective, but if no such date is indicated, the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

7. Hazardous Condition--The presence at the Site of Hazardous Materials in such quantities or circumstances that there is a danger to persons or property.

8. Hazardous Materials--Asbestos, PCB’s, petroleum, hazardous substances, or radioactive material. It is the intention of the parties that these terms be accorded the definition under applicable Laws and Regulations.

9. Laws and Regulations; Laws or Regulations--Any and all applicable laws, rules, regulations, ordinances, codes, standards and orders of any and all governmental bodies, agencies, authorities and courts having jurisdiction.

10. COMMISSIONING AUTHORITY’s Subconsultants--Individuals or entities having a contract with COMMISSIONING AUTHORITY to furnish services with respect to this Project as COMMISSIONING AUTHORITY’s independent professional associates, consultants, subcontractors or vendors. The term COMMISSIONING AUTHORITY includes COMMISSIONING AUTHORITY’s Subconsultants.

11. Reimbursable Expenses--The expenses incurred directly by COMMISSIONING AUTHORITY or its subconsultants for transportation and subsistence; providing and maintaining field office facilities including furnishings and utilities; subsistence and transportation of Resident Project Representatives and their assistants; toll telephone calls and telegrams, copying, facsimile and courier charges, reproduction of reports, Drawings, Specifications, Bidding Documents, and similar Project-related items in addition to those required under Exhibit A, and, if authorized in advance by OWNER, overtime work requiring higher than regular rates. In addition, if authorized in advance by OWNER, Reimbursable Expenses will also include expenses incurred for computer time and the use of other highly specialized equipment.
ARTICLE 8--EXHIBITS

8.01 Exhibits Included

A. Exhibit A, “COMMISSIONING AUTHORITY’s Services,” consisting of _____ pages.

B. Exhibit B, “OWNER’s Responsibilities,” consisting of _____ pages

C. Exhibit C, “Payments to COMMISSIONING AUTHORITY for Services and Reimbursable Expenses,” consisting of _____ pages


F. Exhibit F, “Dispute Resolution,” consisting of ___ pages


8.02 Total Agreement

A. This Agreement (consisting of pages 1 to ____ inclusive, together with the Exhibits identified above) constitutes the entire agreement between OWNER and COMMISSIONING AUTHORITY and supersedes all prior written or oral understandings. This Agreement may only be amended, supplemented, modified or canceled by a duly executed written instrument.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement, the Effective Date of which is indicated on page 1.

OWNER: COMMISSIONING AUTHORITY:

By: By:

Title Title

Address for giving notices: Address for giving notices:

Designated Representative Designated Representative
(paragraph 6.02. A) (paragraph 6.02.A)
Title: 
Phone Number
Facsimile Number
E-Mail Address

Title.
Phone Number:
Facsimile Number:
E-Mail Address:
This is EXHIBIT A, consisting of _____ pages, referred to in and part of the Standard Form of Agreement between OWNER and COMMISSIONING AUTHORITY for Professional Services dated ________________________,_________

COMMISSIONING AUTHORITY’S Services

ARTICLE A1 -- BASIC SERVICES

A1.01 Systems to be Commissioned: The following systems and equipment shall be included in the scope of work described herein: Edit this list to suit the project.

A. Site Utilities, including, but not limited to storm drainage, sanitary sewers, domestic and fire piping, irrigation, and electrical power.

B. Building envelope, including, but not limited to thermal and moisture protection, slab on grade, sub-grade and above-grade walls, doors, fenestration, active and passive shading devices, and roof.

C. Doors and windows with motorized hardware.

D. Equipment, including, but not limited to projection screens and food service equipment.

E. Conveying systems, including, but not limited to escalators, passenger and freight elevators.

F. Plumbing systems, including, but not limited to fire protection, domestic and industrial water supply, waste and vent.

G. Heating systems, including, but not limited to heating hot water generation, distribution, and control.

H. Air conditioning systems, including, but not limited to direct expansion systems, chilled water generation, distribution, and control.

I. Ventilation systems, including, but not limited to supply, return and exhaust air moving equipment, distribution, and control.

J. Building control system, including, but not limited to inputs, outputs, control logic, control processors, communications, user interface.

K. Electrical power, including, but not limited to, distribution, controllers, starters, protective devices, transformers switchboards, panelboards, emergency power generation, distribution and control.

L. Lighting systems, including, but not limited to illuminance and control.

M. Low voltage systems, including, but not limited to fire alarm, access control and security, telecommunications, closed circuit television, paging and audio systems.
A1.02 Pre-Design Phase: The following describes the COMMISSIONING AUTHORITY’S Basic Services for building commissioning during the pre-design phases of work.

A. Project Requirements. Facilitate definition and documentation of the Project Requirements through meetings with Client-designated stakeholders. The Project Requirements document details the functional requirements of a project and the expectations of how it will be used and operated. This includes project and design goals, measurable performance criteria, budgets, schedules, success criteria, design professional qualifications, overall project delivery process, and supporting information. It is anticipated that stakeholders include representatives of occupant and user groups, Physical Plant staff, and community groups.

1. Lead a meeting with stakeholders to draw out issues and criteria to be included in the Project Requirements document.
2. Submit a draft Project Requirements document for stakeholder review.
3. Meet with stakeholders to discuss comments on the draft Project Requirements document.

B. Commissioning Plan: Edit a copy of standard UT Commissioning Plan provided by the Owner to describe the commissioning process and the responsibilities of the commissioning team members (Commissioning Authority, Contractor, designer of record, Construction Manager, subcontractors, and the Owner). The Commissioning Plan is a management plan for commissioning activities.

C. Basis of Design Document Structure. Edit the standard UT Basis of Design document structure, including table of contents, an outline, format and description of contents. The Basis of Design, created by the designer of record, is the formal listing of all information and criteria selected to accomplish the design intent, as documented in the OPR. The Basis of Design includes the building systems’ design concepts and narrative descriptions of how the systems are intended to operate and interact under all anticipated operating conditions. The systems within the commissioning scope are designed, specified, and accepted based on this document. Its development, therefore, must begin at the initial stage of design. This document will include fundamental criteria and concepts that will be further developed and revised as the project progresses. (During the Design Phase, the designer of record develops the contents of the initial Basis of Design document and updates it for the Schematic Design, Design Development, and Construction Documents review submittals.)

1. Submit the Basis of Design document structure for Owner review.

D. Issue Tracking. Record and update an Issues Log to record problems or concerns, and their resolution, which have been raised by members of the Commissioning
E. Review Lessons Learned. Participate in a review of lessons learned from previous commissioning process experiences.

F. Establish Commissioning Budget. Provide a preliminary estimate of the likely cost of the constructor’s participation in the project commissioning process.

G. Determine Commissioning Schedule Expectations. Provide a preliminary estimate of the overall schedule impact of the commissioning process on the project duration. Identify commissioning process milestones and assist the Owner in linking the commissioning process milestones to other project milestones.


J. Write Predesign Commissioning Report. At the end of the Predesign Phase, write a summary report of the status of commissioning work, including issues resolved and remaining open. Recommend acceptance of the Predesign Phase work. If the Predesign documents are not ready for acceptance, identify actions necessary to resolve outstanding review comments and open issues in order to bring the project to a condition that warrants a recommendation for acceptance.

K. Deliverables, Pre-Design Phase:
   1. Project Requirements document
   2. Commissioning Plan
   4. Issues Log
   5. Commissioning budget estimate
   6. Commissioning schedule expectations
   7. Systems Manual
   8. Commissioning review comments on Predesign documents
   9. Predesign Phase Commissioning Report

A1.03 Design Phase: The following describes the COMMISSIONING AUTHORITY’S Basic Services for building commissioning during the design phases of work.

A. Update Project Requirements Document. Review proposed changes to Project Requirements document for consistency and adequacy of definition. Update Project Requirements document with approved changes.

B. Update Commissioning Plan: Refine and update the Commissioning Plan as the
project progresses. Submit a revised plan at the conclusion of each of the following project milestones: Schematic Design; Design Development; Construction Documents.

C. Issue Tracking. Record and update an Issues Log to record problems or concerns, and their resolution, which have been raised by members of the Commissioning Team during the Design Phase.

D. Review Basis of Design. Review Basis of Design document at the conclusion of each of the following project milestones: Schematic Design; Design Development; Construction Documents.

E. Commissioning Review of Design Phase Documents: Review project documents and provide written comments on commissioning-related issues at the conclusion of each of the following project milestones: Schematic Design; Design Development; Construction Documents. Project documents include Basis of Design document, calculations, drawings and the project manual. Review goals include:

1. Evaluate general quality of documents, extent of completion and coordination.
2. Evaluate compliance with the Project Requirements. Identify features that compromise the ability of systems to perform in accordance with the Project Requirements.
3. Identify the need for additional instrumentation or control devices required to perform commissioning procedures and monitor system performance.
4. Identify inadequate access for operations, maintenance, replacement, or testing.


G. Write Commissioning Specifications: For the equipment and systems included in the Scope of Work, provide to OWNER for review and approval, integrated building commissioning specifications. Coordinate commissioning specifications with the designer of record’s technical specifications for the equipment and systems listed above. Revise as needed. Prepare commissioning specifications for publication in bid documents by the designer of record.

1. Specifications shall require the contractor to schedule, coordinate and perform device tests, calibration, air and hydronic balancing, and commissioning tests of system and intersystem performance. The Contractor will conduct tests in accordance with approved test procedures written by the Commissioning Authority.
2. Commissioning specifications include draft construction checklists for use by the contractor.
3. Commissioning specifications include draft commissioning test
procedures and data forms for use by the contractor. Commissioning test procedures describe the scope of testing in terms of equipment and systems to be tested, functions to be tested, conditions under which the tests are to be performed, the range of acceptable results, and provide step-by-step instructions for executing the tests.

H. Define Training Requirements. Consult with Owner staff to determine specific training requirements. Document findings as recommendations for inclusion in bid documents by designer of record.

I. Write Design Phase Commissioning Report. At the end of the Design Phase, write a summary report of the status of commissioning work, including issues resolved and remaining open. Recommend acceptance of the Design Phase work preparatory to issuing bid documents. If the Design documents are not ready for acceptance, identify actions necessary to resolve outstanding review comments and open issues in order to bring the project to a condition that warrants a recommendation for acceptance.

J. Deliverables, Design Phase:
   1. Updated Project Requirements document
   2. Updated Commissioning Plan
   3. Issues Log
   4. Commissioning review comments at three milestones
   5. Updated Systems Manual
   6. Commissioning specifications
   7. Training Requirements recommendations
   8. Design Phase Commissioning Report

A1.04 Bidding Period: The following describes the COMMISSIONING AUTHORITY’S Basic Services for building commissioning during the Bidding Period. Note: This article may not apply for projects to be constructed by UT forces.

   A. Pre-Bid Meeting. Attend prebid meeting to discuss contractor commissioning requirements.
   B. Bidder Queries. Respond to bidder queries regarding contractor commissioning requirements.

A1.05 Construction Phase: The following describes the COMMISSIONING AUTHORITY’S Basic Services for building commissioning during the construction phase of work.

   A. Update Project Requirements Document. Review proposed changes to Project Requirements document for consistency and adequacy of definition. Update Project Requirements document with approved changes.
C. Commissioning Plan: Refine and update the plan as the project progresses. Submit a revised plan at the start of Construction. Update the roster of Commissioning Team members.

D. Coordinate UT Staff Involvement in Commissioning. Coordinate with Contractor to schedule UT staff reviews of various submittals, and site visits to observe installation, witness tests and participate in training.

E. Commissioning Meetings: Attend and lead periodic on-site Commissioning Meetings. Prepare and distribute meeting agenda and meeting notes. Note: Edit the frequency of meetings to coincide with anticipated need during the project.
   1. Pre-construction commissioning meeting
   2. Monthly meetings before the start of commissioning testing
   3. Weekly meetings during the Acceptance Period.

F. Submittal Review: Review Contractor product submittals and shop drawings of central equipment (air handlers, chillers, cooling tower, boiler, pumps, emergency generator set, electrical switchgear) and control systems (HVAC, lighting, fire alarm, security). Review specified Contractor commissioning submittals, including periodic commissioning schedule updates. Review shall be performed concurrently with designer of record review. Provide timely written comments to the designer of record.


H. Commissioning Test Procedures. For equipment and systems included in the scope of work, following approval of equipment submittals and shop drawings, prepare working commissioning test procedures and data forms. Submit procedures and data forms for Owner, designer of record and Contractor review. Make changes as required.

I. Installation Verification:
   1. For equipment and systems included in the scope of work, prepare prefunctional checklists for use by Contractor.
   2. Review Contractor-completed prefuctional checklists before installation observation.
   3. Periodically perform site visits to observe and evaluate quality of contractor work and compliance with Project Requirements and the construction contract. Verify Contractor Checklists by use of a statistical sampling method, with a sample size of approximately ______ percent. Coordinate timing of site visits to coincide with the beginning of installation of each system in each major increment of the contractor’s work. Report observations to Owner in writing.

J. Training: Monitor Contractor training of Owner staff. Report observations and
recommendations for acceptance of training.

K. Witness Equipment Startup: For the following equipment and systems, witness Contractor performance of specified startup procedures. Report observations and recommendations for acceptance of startup.

1. Chillers,
2. Boilers,
3. Air handling units,
5. ________________

L. Verify Test Data Reports. Review Contractor commissioning test records for completion and acceptability of reported results.

M. Witness Commissioning Tests. For equipment and systems included in the scope of work, witness a sample of Contractor performance of specified commissioning tests, including commissioning tests of components, equipment, systems; and intersystem functions. Report commissioning test results and observations. Recommend acceptance of commissioning test results. The following sampling rates are to be used: Note: The following are examples and should be replaced by a list of systems/equipment specific to the project, with appropriate sampling rates.

1. Heating, ventilation, and air-conditioning (HVAC) control input/output components: 10%
2. HVAC equipment sequence of control: 50%
3. Testing, adjusting and balancing of air and water distribution: 15%
4. Emergency power transfer switch: 100%
5. Fire alarm initiating devices: 100%
6. Lighting controls: 15%

N. Issue Tracking. Record and update an Issues Log to record problems or concerns, and their resolution, which have been raised by members of the Commissioning Team during the Construction period. Participate in resolution of issues for which there is not agreement on appropriate solution.

O. Commissioning Reports

1. Weekly: During the acceptance period, provide written Commissioning Progress Reports. Commissioning Progress Reports include commissioning activities, status of the commissioning process, and summaries of test results for the week.

2. Summary: Write Construction Phase Summary Commissioning Report to describe and evaluate the results of the commissioning process. Submit three copies of draft for review. Make revisions as required. Provide three
copies of report. Report shall include:

a. Recommendation for acceptance of construction work
b. Executive summary
c. Commissioning Plan
d. Project Requirements
e. Basis of Design
f. Commissioning review comments
g. Commissioning meeting agenda and notes
h. Submittal review comments
i. Physical locations of copies of systems manuals
j. Commissioning test procedures
k. Prefunctional checklists
l. Installation verification reports
m. Site observation reports
n. Training status reports
o. Startup status reports
p. Commissioning test results and status reports
q. TAB report
r. TAB verification status report
s. Commissioning deficiency reports and tracking log
t. Commissioning progress reports

P. Deliverables, Construction Phase:
1. Updated Project Requirements Document
2. Basis of Design review comments
3. Updated Commissioning plan
4. Commissioning meeting agenda and notes
5. Submittal review comments
7. Commissioning test procedures
8. Commissioning checklists
9. Installation verification reports
10. Site observation reports
11. Training status reports
12. Startup status reports
13. Commissioning test status reports
14. Issues Log
15. Weekly commissioning progress reports
16. Construction Phase Summary Commissioning Report

A1.06 Warranty Period: The following describes the COMMISSIONING AUTHORITY’S Basic Services for building commissioning during the warranty period. The warranty period is the calendar year following Substantial Completion.

A. Submit project to Warranty Team. Follow the Owner’s project warranty turnover procedure to submit the project to the warranty team.

B. Deferred Commissioning Tests: In conjunction with the contractor and the OWNER’S staff, coordinate and manage execution of deferred commissioning tests during the warranty period. Deferred commissioning tests include tests that could not be performed during the construction phase due to absence of load resulting from climatic or occupancy conditions beyond the contractor’s control.
   1. Provide deferred commissioning test procedures.
   2. Schedule, coordinate and direct the execution of deferred commissioning test procedures.
   3. Document deferred commissioning test results and deficiencies.
   4. Track and manage resolution of warranty period deficiencies.
   5. Report observations and status of deferred commissioning tests periodically.

C. End-of Warranty Period Evaluation/Tests. In conjunction with the contractor and the OWNER’S staff, coordinate and manage execution of end-of warranty period evaluation/tests to determine if system adjustments are needed to optimize system operation or otherwise bring it into accord with the Project Requirements.
   1. Provide end-of warranty period evaluation/test procedures.
   2. Schedule, coordinate and direct the execution of end-of warranty period evaluation/test procedures.
   4. Track and manage resolution of warranty period deficiencies.
   5. Report observations and status of end-of-warranty period evaluation/tests.

D. Lessons-learned Workshop. Conduct, document, and distribute the results of a lessons-learned workshop to evaluate the success of the commissioning process.

E. Commissioning Report Supplement. When deferred tests and end-of-warranty
period evaluation/tests are complete, prepare a supplement to the Construction Phase Commissioning Summary Report. Together, the Construction Phase Commissioning Summary Report and the supplement, constitute the Project Commissioning Report. The Project Commissioning Report is the final commissioning report for the renovation project.

The Project Commissioning Report contains all documentation and correspondence related to the Commissioning Process. It is a complete record of the renovation project Commissioning Process and its results. Prepare a supplement to the commissioning report to incorporate warranty period commissioning activities. Report shall include:

1. Executive summary
2. Lessons learned report
3. Deferred and end-of-warranty test procedures, results, and reports
4. Warranty period deficiency reports


ARTICLE A2 — ADDITIONAL SERVICES

A2.01 When authorized by OWNER, provide the following commissioning services.

A. Conformance Testing:
   1. Witnessing of source quality control procedures for ________

B. Commissioning testing:
   1. Supervise performance testing of ________________
   2. Perform performance testing of ________________
   3. Validate total building performance

C. Organization and indexing of record documents.

D. F. Training for ____________________________

END OF AGREEMENT
APPENDIX C
PROJECT REQUIREMENTS DOCUMENT OUTLINE

Renovation Project Master Commissioning Plan

Explanatory Notes: This outline presents a structure on which the Project Requirements document may be built. Edit the outline as appropriate for each particular project.

Determine the project-specific content associated with each line item by conducting a project requirements workshop. Use nominal group techniques to solicit input from all participants and to rank the issues for inclusion in the Project Requirements document.

I Introduction
   A. Commissioning Process scope and budget

II Key Owner’s Project Requirements
   A. Project documentation requirements, including format for submittals, training materials, reports, and the Systems Manual. Consideration should be given to use of electronic format documents and records where appropriate
   B. Owner directives
   C. Program requirements
   D. Training requirements for Owner’s personnel
   E. Warranty requirements
   F. Equipment and system maintainability expectations, including limitations of operating and maintenance personnel
   G. Benchmarking requirements
   H. Operation and maintenance criteria for the facility that reflect the Owner’s expectations and capabilities and the realities of the facility type
   I. Quality requirements for materials and construction
   J. Energy efficiency goals
   K. Environmental and sustainability goals
   L. Community requirements
   M. Adaptability for future facility changes and expansion
   N. Health, hygiene, and indoor environment requirements
   O. Acoustical requirements
   P. Vibration requirements
Q. Seismic requirements
R. Accessibility requirements
S. Security requirements
T. Aesthetics requirements
U. Constructability requirements
V. Communication requirements

III General Project Description
A. Project schedule and budget
B. Restrictions and limitations
C. Applicable codes and standards

IV Objectives
A. Equipment and system maintainability expectations, including limitations of operating and maintenance personnel
B. Allowable tolerance in facility system operations
C. Energy efficiency goals
D. Environmental and sustainability goals
E. Adaptability for future facility changes and expansion

V Functional Uses
A. Occupancy requirements and schedules
B. Adaptability for future facility changes and expansion
C. Systems integration requirements, especially across disciplines

VI Occupancy Requirements
A. Occupancy requirements and schedules
B. Health, hygiene, and indoor environment requirements

VII Budget Considerations and Limitations
A. Project schedule and budget
B. Commissioning Process scope and budget

VIII Performance Criteria
A. General
   1. Quality requirements for materials and construction
   2. Environmental and sustainability goals
   3. Community requirements
   4. Systems integration requirements, especially across disciplines
5. Acoustical requirements
6. Vibration requirements
7. Seismic requirements
8. Accessibility requirements
9. Security requirements
10. Aesthetics requirements
11. Constructability requirements
12. Communication requirements

B. Economic
1. Benchmarking requirements
2. Energy efficiency goals

C. User Requirements
1. Program requirements
2. Health, hygiene, and indoor environment requirements
3. Acoustical requirements
4. Accessibility requirements
5. Security requirements
6. Aesthetics requirements
7. Communication requirements

D. Construction Process
1. Training requirements for Owner’s personnel
2. Equipment and system maintainability expectations, including limitations of operating and maintenance personnel
3. Benchmarking requirements
4. Quality requirements for materials and construction
5. Adaptability for future facility changes and expansion
6. Systems integration requirements, especially across disciplines
7. Acoustical requirements
8. Vibration requirements
9. Seismic requirements
10. Accessibility requirements
11. Security requirements
12. Aesthetics requirements
13. Constructability requirements

14. Communication requirements

E. Operations
   1. Training requirements for Owner’s personnel
   2. Warranty requirements
   3. Equipment and system maintainability expectations, including limitations of operating and maintenance personnel
   4. Benchmarking requirements
   5. Operation and maintenance criteria for the facility that reflect the Owner’s expectations and capabilities and the realities of the facility type
   6. Allowable tolerance in facility system operations
   7. Energy efficiency goals
   8. Adaptability for future facility changes and expansion
   9. Accessibility requirements

F. Systems
   1. Equipment and system maintainability expectations, including limitations of operating and maintenance personnel
   2. Benchmarking requirements
   3. Operation and maintenance criteria for the facility that reflect the Owner’s expectations and capabilities and the realities of the facility type
   4. Quality requirements for materials and construction
   5. Allowable tolerance in facility system operations
   6. Energy efficiency goals
   7. Adaptability for future facility changes and expansion

G. Equipment
   1. Operation and maintenance criteria for the facility that reflect the Owner’s expectations and capabilities and the realities of the facility type
   2. Quality requirements for materials and construction
   3. Energy efficiency goals
   4. Adaptability for future facility changes and expansion

IX PR Version History
   A. For each revision of the PR document, record:
      1. Revision date
      2. Revised by
3. Reason for revision
### APPENDIX D
### DESIGN DELIVERABLES

#### Renovation Project Master Commissioning Plan

The following is a table of Design Delivery Requirements. It is included in the Project Requirements, and should be included in the prime design consultant agreement.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SCHEMATIC</th>
<th>DESIGN DEVELOPMENT</th>
<th>CONSTRUCTION DOCUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SPECIFICATION</strong></td>
<td>System &amp; material narrative description</td>
<td>Outline specification</td>
<td>Complete specification</td>
</tr>
<tr>
<td><strong>CADD ELECTRONIC FILES</strong></td>
<td>Samples of CADD files from all project consultants</td>
<td>Samples of CADD files corrected to meet the Owner’s standards</td>
<td>Complete &amp; accurate CADD files (all drawings)</td>
</tr>
<tr>
<td><strong>SITE</strong></td>
<td>Existing conditions&lt;br&gt;Site footprint&lt;br&gt;Site entrance&lt;br&gt;Demolition&lt;br&gt;Site utilities&lt;br&gt;Utility requirements&lt;br&gt;Roads &amp; driveways&lt;br&gt;Loading dock location&lt;br&gt;Future expansion&lt;br&gt;Walkway locations&lt;br&gt;Stairway locations&lt;br&gt;Parking locations&lt;br&gt;Waste collection locations</td>
<td>Pedestrian circulation&lt;br&gt;Utility details&lt;br&gt;Dimensions&lt;br&gt;Traffic flow plan&lt;br&gt;Handicapped flow plan&lt;br&gt;Lighting plan&lt;br&gt;Stairway connections&lt;br&gt;Waste Containers&lt;br&gt;Bicycle facilities&lt;br&gt;Site drainage</td>
<td>Pipe sizes&lt;br&gt;Connection details&lt;br&gt;Contractor parking&lt;br&gt;Construction area&lt;br&gt;Construction phasing&lt;br&gt;Site development phasing&lt;br&gt;Street use plan</td>
</tr>
<tr>
<td><strong>LANDSCAPING</strong></td>
<td>Existing conditions&lt;br&gt;Existing irrigation&lt;br&gt;Irrigation legend</td>
<td>Irrigation plan&lt;br&gt;Planting plan</td>
<td>Soil preparation &amp; planting specifications&lt;br&gt;Guying details&lt;br&gt;Piping diagrams&lt;br&gt;Pipe sizes&lt;br&gt;Design calculations&lt;br&gt;Existing tree protection</td>
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</tbody>
</table>

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Revised 15 December 2005
<table>
<thead>
<tr>
<th>ITEM</th>
<th>SCHEMATIC PHASE</th>
<th>DESIGN DEVELOPMENT PHASE</th>
<th>CONSTRUCTION DOCUMENT PHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUILDING EXTERIOR ENVELOPE</td>
<td>Typical elevations Building cross-sections Fenestration layout Material designations Energy code requirements Roof layout</td>
<td>Typical wall sections Typical window details Exterior door details Roof &amp; drainage plan Parapet &amp; coping details</td>
<td>Roof details Exterior details Roof mounted equipment Flashing details</td>
</tr>
<tr>
<td>STRUCTURAL</td>
<td>Structural scheme Written description including seismic analysis of existing bldg. &amp; proposed strengthening techniques Structural legend</td>
<td>Structural sections Typical floor framing plan Main member sizing Foundation Plan</td>
<td>Structural details Foundation details Beam &amp; column schedules Structural notes Calculations</td>
</tr>
<tr>
<td>BUILDING INTERIOR</td>
<td>Typical floor plans (min. 1/16” scale) Area use identification &amp; area in sq. Ft. Janitor closet(s) location(s) Circulation paths Preliminary layouts of major lab spaces Show flexibility for expansion and alterations All room numbers Area tabulations compared to program requirements Cost study: existing, area separation, etc. Mechanical, electrical and other service closets and rooms</td>
<td>All floor plans (min. 1/16” scale) Wall types, fire ratings, smoke control zones Partition types Defined seating, serving &amp; kitchen facilities Fixed seating Equipment &amp; furniture layouts</td>
<td>Dimensioned floor plans Finish schedules Door &amp; hardware schedules Interior elevations Reflected ceiling plans Partition details Interior details</td>
</tr>
<tr>
<td>ITEM</td>
<td>SCHEMATIC PHASE</td>
<td>DESIGN DEVELOPMENT PHASE</td>
<td>CONSTRUCTION DOCUMENT PHASE</td>
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<td>--------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
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<tr>
<td>ELEVATORS</td>
<td>Elevator location(s)</td>
<td>Elevator shaft section</td>
<td>Dimensioned plans</td>
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<td></td>
<td>Equipment room location(s)</td>
<td>Equipment description</td>
<td>Complete specification</td>
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<td>Elevator legend</td>
<td></td>
<td>Door &amp; frame details</td>
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<td></td>
<td></td>
<td>Interior details with lighting</td>
</tr>
<tr>
<td>PLUMBING &amp; PIPING</td>
<td>Location of headers</td>
<td>Water header diagram</td>
<td>Pipe sizes</td>
</tr>
<tr>
<td></td>
<td>Location of pipe chases</td>
<td>Central cooling water header diagram</td>
<td>Radiation riser diagram</td>
</tr>
<tr>
<td></td>
<td>Fixture locations</td>
<td>Steam header diagram</td>
<td>Plumbing riser diagram</td>
</tr>
<tr>
<td></td>
<td>Mechanical legend</td>
<td>Piping plans</td>
<td>Water header diagram</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Steam header diagram</td>
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<td></td>
<td></td>
<td>Central cooling water riser diagram</td>
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<td></td>
<td>Chilled water riser diagram</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Coil piping detail</td>
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<td></td>
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<td></td>
<td>Conveter piping detail</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Water header piping detail</td>
</tr>
<tr>
<td>HVAC</td>
<td>Identify all systems</td>
<td>Preliminary calculations</td>
<td>Equipment details</td>
</tr>
<tr>
<td></td>
<td>One-line flow diagrams</td>
<td>One-line duct layout</td>
<td>Installation details</td>
</tr>
<tr>
<td></td>
<td>Energy code requirements</td>
<td>Equipment list</td>
<td>Cross sections</td>
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<tr>
<td></td>
<td>Special occupancy zones</td>
<td>Equipment locations</td>
<td>Connection to FA &amp; MCC</td>
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<tr>
<td></td>
<td>Mechanical legend</td>
<td>Control diagram</td>
<td>Design calculations</td>
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<tr>
<td></td>
<td>Air intake &amp; discharge locations</td>
<td>Sequence of operation</td>
<td></td>
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<td></td>
<td></td>
<td>M/E smoke control scheme (matrix)</td>
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<tr>
<td>FIRE PROTECTION (MECHANICAL)</td>
<td>Connection to utility</td>
<td>Riser diagram</td>
<td>Complete specifications</td>
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<td></td>
<td>Location of sprinkler valve</td>
<td>One-line layout</td>
<td>Sprinkler valve details</td>
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<td></td>
<td>Sprinkler legend</td>
<td></td>
<td>Header &amp; piping layouts</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Pipe sizes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Design calculations</td>
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<td>LIGHTING</td>
<td>Zones w/foot-candles</td>
<td>Fixture/switching layout</td>
<td>Fixture schedule</td>
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<td></td>
<td>Fixture types</td>
<td></td>
<td>Installation details</td>
</tr>
<tr>
<td></td>
<td>Energy code requirements</td>
<td>Light level calculations</td>
<td>Control diagram</td>
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<td>Design calculations</td>
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<tr>
<td>ITEM</td>
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<td>DESIGN DEVELOPMENT PHASE</td>
<td>CONSTRUCTION DOCUMENT PHASE</td>
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<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ELECTRIC POWER DISTRIBUTION</td>
<td>One-line diagrams Electric vault location Electric closet(s) location(s) Electric legend</td>
<td>Equipment layout/sizes Panel locations/ schedules Power riser diagram Load estimate</td>
<td>Load summary Panel schedules Connection to FA &amp; HVAC MCC details Design calculations</td>
</tr>
<tr>
<td>FIRE ALARM</td>
<td>Connection to utility Panel location</td>
<td>Fire alarm zones Smoke zones Device locations Riser diagram</td>
<td>Connection details Connection to FA &amp; HVAC Riser diagram</td>
</tr>
<tr>
<td>TELECOMMUNICATIONS</td>
<td>Building &amp; local distribution Frame closet locations &amp; size Cable tray outlet</td>
<td>Riser diagrams Material cut-sheets Conduit plans Voice/data utility outlet locations</td>
<td>Backboard layout &amp; connection diagrams Connection details Cable schedule</td>
</tr>
<tr>
<td>SERVICE FACILITIES</td>
<td>Loading dock Service elevator Service road</td>
<td>Waste containers Recycle holding area Bottled gas area Any special waste handling Service vehicle parking area</td>
<td>Details for all accessory &amp; support apparatus in each area</td>
</tr>
<tr>
<td>HANDICAPPED PROVISIONS</td>
<td>Access locations Restrooms</td>
<td>Ramped accesses</td>
<td>Details for all associated accessories &amp; provisions</td>
</tr>
<tr>
<td>PERSONAL SAFETY PROVISIONS</td>
<td>Design considerations leading to an inherently safe occupancy environment</td>
<td>Any special systems or applications promoting personal safety</td>
<td>Details required for personal safety provisions</td>
</tr>
<tr>
<td>COMMISSIONING</td>
<td>Basis of Design Basis of Design update One-line diagrams Calculations System zoning Sequences of operation with logic diagrams All data required in the PR</td>
<td>Production of the document required in the PR Preparation of the contract documents in accordance with the requirement of the PR Interface wiring diagrams</td>
<td></td>
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# APPENDIX E

## BASIS OF DESIGN DOCUMENTATION OUTLINE

### Renovation Project Master Commissioning Plan

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<td>O</td>
<td>Air Handling Systems</td>
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<td>P</td>
<td>HVAC Control System</td>
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<td>Q</td>
<td>HVAC Systems Load Calculations</td>
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<td>R</td>
<td>Other Equipment and Systems Criteria</td>
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</tr>
<tr>
<td>S</td>
<td>Electrical Systems</td>
<td></td>
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</tbody>
</table>
A. Basis of Design Document, Concept and Use:

This Basis of Design Outline provides a model for the creation of the Basis of design for a specific project. Provide a copy of this Outline to the Design Architect and Engineer for their use.

The Basis of Design (BOD) Document for [project] records the concepts, design assumptions, important calculations, decisions, and product selections used to satisfy the Project Requirements (PR), regulatory requirements, and industry standards and guidelines. The document consists of narrative descriptions and data that support the design process. It evolves throughout the design process, constantly cross-referencing the PR, and documenting and explaining the reasons for changes as they occur. Updated editions of the Basis of Design Document are required as a part of each design submittal, in accordance with the following guidelines:

- **Predesign**: Developed by Commissioning Authority (CA); reviewed by Owner
  - Outline of contents
  - Concept format

- **Schematic Design**: Predesign Outline developed into Schematic Document by Design Architect and Engineers; reviewed by CA & Owner. Submittal includes:
  - Design Priorities
  - Building Structure, Appearance, Dimensions and Finishes
  - Initial building envelop assumptions
  - Initial energy efficiency
  - Outdoor design conditions
  - Indoor design criteria
  - Construction phasing criteria and initial phasing plans
  - Description, including area served, and system 1-line for each major system
  - Systems’ sequences of operation and rational
  - Systems sizing criteria

- **Design Development**: Document updated by Design Architect and Engineers; reviewed by CA & Owner. Submittal includes:
  - Update of all information provided at schematic design
  - HVAC load calculations by system, - sum of zone peak loads, system peak load (including diversity, and specified system capacity
  - Control logic for implementation of all sequences of operation
  - Equipment selection criteria including HVAC load, capacity, diversity, safety, reserve capacity for future use, and noise criteria; electrical requirements; estimated weight and clearances for maintenance access.
  - Maintenance considerations for each system
  - Detailed phasing plans
• **Construction Documents**: Document updated by Design Architect and Engineers; reviewed by CA & Owner. Entire document completed.

### B. Design Priorities

1. **Identify priorities**: Discuss prioritization of the design considerations, goals and criteria with respect to applicable codes and standards and the PR document:

2. **Priority assignment**: Assign numerical priority to the project design goals and criteria. Assign priority for each of the major design considerations; 1 for the highest, 2 for the next highest, etc. Do not assign the same priority to more than one consideration. Note that all code, jurisdictional, regulatory and other legally mandated requirements will be met regardless of the priorities assigned by the BOD document. The following table is an example.

<table>
<thead>
<tr>
<th>Design Goals / Criteria</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project cost</td>
<td></td>
</tr>
<tr>
<td>Minimizing disruption of facility operations</td>
<td></td>
</tr>
<tr>
<td>Occupant safety</td>
<td></td>
</tr>
<tr>
<td>Laboratory function</td>
<td></td>
</tr>
<tr>
<td>Flexibility/adaptability to future needs</td>
<td></td>
</tr>
<tr>
<td>Occupant comfort</td>
<td></td>
</tr>
<tr>
<td>Energy efficiency and environmental impacts (sustainable practices)</td>
<td></td>
</tr>
<tr>
<td>Maintainability and operability</td>
<td></td>
</tr>
<tr>
<td>Building appearance</td>
<td></td>
</tr>
<tr>
<td>On campus noise and noise in adjacent community</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

3. **Adjustment for Project Requirements**: The Design Goals / Criteria in the table above are for use as a guideline. The list is not complete, and some criteria may not apply to a particular project. Therefore the Design Goals / Criteria should be changed and modified according to the dictates of the specific project.

4. **Priority deviations and changes**: As the project develops, it may be necessary to revise the Priority assigned to each criterion. Document any such change or deviation and describe the rationale:

### C. Building Structure

1. **Building**
   a. Construction type / materials (describe):
   b. Rationale (describe rationale used to determine type(s)):

2. **Roof**
   a. Construction type / materials (describe):
b. Rationale (describe rationale used to determine type(s)):

3. Equipment screening (including dimensions)
   a. Construction type / materials (describe):
   b. Rationale (describe rationale used to determine type(s)):

D. **Building appearance:**
   General discussion of criteria for building appearance:

E. **Building Dimensions**
   Discuss rationale used to determine the building and room dimensions:
   1. Chiller room:
   2. Hazardous materials storage areas:
   3. Maintenance stores and work areas:
   4. Other:

F. **Building Materials and Finishes**
   Discuss reasons for selecting:
   1. Interior finishes
   2. Exterior finishes
   3. Other:

G. **Outdoor Design Conditions**
   Used for heating and cooling loads
   1. **Winter**
      a. ASHRAE design level: (location and percent)
      b. Dry bulb:
   2. **Summer**
      a. ASHRAE design level: (location and percent)
      b. Dry bulb:
      c. Coincident Wet bulb:

H. **Indoor Design Criteria – General**
   Used for heating and cooling loads
   1. **Indoor design temperatures**
      a. Applicable codes and standards for heating and cooling setpoints: (Enter codes and standards upon which the design is based, i.e. State energy code, special user requirements, etc)
         1)
         2)
2. **Design setpoint(s):**

I. **Building Envelope**

1. **Location** (Describe):
   a. **Infiltration assumptions** (describe assumptions)
      1) Wind speed and direction
      2) Building pressure relative to outdoor ambient
   b. **Moisture permeability assumptions:** (describe typical conditions and special considerations for spaces with atypical requirements)
      1) Walls
      2) Foundation / slab
      3) Roof
   c. **Foundation/slab**
      1) Assemblies (description or sketch of resection):
      2) U-value per layer:
      3) Convection loss:
      4) Total equivalent U-value/linear foot:
   d. **Walls**
      1) Assemblies (description or sketch of resection):
      2) U-value per layer:
      3) Convection loss:
      4) Infiltration:
      5) Total equivalent U-value/square foot:
   e. **Doors**
      1) Assemblies (description or sketch of resection):
      2) U-value per layer:
      3) Convection loss:
      4) Infiltration:
      5) Total equivalent U-value/square foot:
   f. **Windows / glass**
      1) Assemblies (description or sketch of resection):
      2) U-value/square foot:
      3) Shading coefficient:
      4) Building shading factors:
      5) Infiltration:
g. **Roof**
   1) Assemblies (description or sketch of resection):
   2) U-value per layer:
   3) Convection loss:
   4) Infiltration:
   5) Total equivalent U-value/square foot:

2. **Location:** Repeat section A.1 for each section of the building according to variations in type of foundation, wall, door, window, or roof.

J. **Energy Efficiency and Sustainable Practices Design**

1. **Energy Efficiency** (Describe how the design and construction documents will comply with codes and standards, and respond to the PR document, regarding energy efficiency for each area and system within the project):
   a. Applicable codes and standards (Enter ventilation codes and standards upon which the design is based, special user requirements, etc.):
      1) 
      2) 
   b. Equipment & motors
   c. Lighting
   d. Annual energy use projections

2. **Sustainable Practices Design**
   a.

3. **Section 918 Energy Analysis**
   a.

K. **Construction Phasing**

1. Area or System: (as appropriate)
   a. Narrative (describe general issues and considerations used in developing construction phasing plan and challenges remaining to be addressed)
   b. Acceptable down time: (List the interrupted services and indicate the acceptable down time durations and periods)
   c. Phasing plan: (Describe how the work will be accomplished in order to keep down time to acceptable time period.)

L. **Noise and vibration transmission to adjacent areas**

Discuss noise and vibration criteria for areas adjacent to the project:

1. Applicable codes and standards: (Enter codes and standards upon which the design is based, i.e. ASHRAE Applications, special user requirements, etc.)
   1)
2)  

2. List the noise criteria for each space type. (The following table is an example.)
   a. Design noise criteria

<table>
<thead>
<tr>
<th>Space</th>
<th>Criteria</th>
<th>Governing code or standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjacent Building</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facility Grounds</td>
<td></td>
<td></td>
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<tr>
<td>Surrounding Neighborhood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classroom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance Space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. List the vibration criteria for each space type (The following table is an example.)
   a. Design noise criteria

<table>
<thead>
<tr>
<th>Space</th>
<th>Typical Application</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office &amp; Common Spaces</td>
<td>Clerical/office work; meeting rooms; conference rooms</td>
<td></td>
</tr>
<tr>
<td>Classroom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance Space</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

M. Equipment Noise and vibration

Discuss noise and vibration criteria for all major equipment (describe issues and standards used in developing the criteria):

1. Air handlers and fans
   a. Criteria:
   b. Source:
   c. Issues:
2. Boilers
   a. Criteria:
   b. Source:
   c. Issues:
3. Generators
a. Criteria:
b. Source:
c. Issues:

1.4. Chillers
   a. Criteria:
   b. Source:
   c. Issues:

1.5. Pumps
   a. Criteria:
   b. Source:
   c. Issues:

1.6. Cooling Towers
   a. Criteria:
   b. Source:
   c. Issues:

7. Transformers
   a. Criteria:
   b. Source:
   c. Issues:

4.8. Other
   a. Criteria:
   b. Source:
   c. Issues:

N. Chilled Water System

1. System description (describe existing system and modifications for this project, attach system 1-line diagrams):

2. Describe selection criteria and rationale (with respect to owner requirements, building cooling load, spare capacity, safety factors, existing system limitations, etc), including systems considered & rejected, used to select this system. If existing equipment is to be used discuss the extent of refurbishment and rational for this:

3. System operation: describe each mode of operation and transitions between modes
   a. Normal (occupied):
   b. Partial occupancy (nights, holidays, weekends?):
   c. Unoccupied (nights, holidays, weekends?):
   d. Emergency:
4. Rationale for system operation sequences of control
   a. Schedule of building occupancy
   b. Equipment protection considerations (i.e. freeze protection, compressor protection upon loss of chilled water flow, etc.)
   c. Energy considerations
   d. Other
5. Chilled water distribution system sizing criteria (including pumping)
   a. Pipe sizing & velocity criteria
      
      | Pipe size range | Max velocity (FPM) | Max loss (‘HD/100LF) |
      |----------------|-------------------|---------------------|
      |                 |                   |                     |
      |                 |                   |                     |
      |                 |                   |                     |
      |                 |                   |                     |

   b. Component pressure drops
      
      | Component   | Max velocity (FPM) | Max loss (‘HD/100LF) |
      |-------------|-------------------|---------------------|
      |             |                   |                     |
      |             |                   |                     |
      |             |                   |                     |
      |             |                   |                     |

   c. Distribution temperature and ΔT.
      
      | Equipment    | Supply °F | Return °F | ΔT °F |
      |--------------|-----------|-----------|-------|
      | System (Chillers) |         |           |       |
      | AHUs         |           |           |       |
      | Terminal Units |         |           |       |
      |              |           |           |       |
      |              |           |           |       |
      |              |           |           |       |

   d. Pumps
      1) Discuss rationale for selecting this style or type of equipment:
      2) Describe criteria and rationale used to size and select the equipment, and to schedule its scheduled capacity and TAB settings:
         (a) Owner requirements:
(b) Facility cooling load:
(c) Spare capacity:
(d) Safety factors:
(e) Diversity:
(f) Existing limitations:
(g) Refrigerant type and quantity
(h) Other:
(i) Other:

3) Summary Table

<table>
<thead>
<tr>
<th>Pump</th>
<th>Circuit or Equipment served</th>
<th>Sum of Zone Peaks (GPM)</th>
<th>System Peak Schedule</th>
<th>Equipment Schedule</th>
<th>TAB Schedule</th>
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<tbody>
<tr>
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<td>GPM</td>
<td>Ft. HD.</td>
<td>GPM</td>
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<tr>
<td>Secondary (Distribution) Pumps</td>
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<td>Condenser Water Pumps</td>
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<tr>
<td>Other</td>
<td></td>
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</table>

6. Chillers

   a. Discuss rationale for selecting this style or type of equipment:
b. Describe criteria and rationale used to size and select the equipment, and to schedule its scheduled capacity and TAB settings:

1) Owner requirements:
2) Facility cooling load:
3) Spare capacity:
4) Safety factors:
5) Diversity:
6) Existing limitations:
7) Other:
8) Other:

c. Summary Table

<table>
<thead>
<tr>
<th>CH #</th>
<th>Ton s</th>
<th>Evaporator</th>
<th>Condenser</th>
<th>KW</th>
<th>KW / Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>GP M</td>
<td>Max ΔP</td>
<td>°F In</td>
<td>°F Out</td>
</tr>
<tr>
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</tr>
</tbody>
</table>

7. Cooling Towers

a. Discuss rationale for selecting this style or type of equipment:

b. Describe criteria and rationale used to size and select the equipment, and to schedule its scheduled capacity and TAB settings:

1) Owner requirements:
2) Facility cooling load:
3) Spare capacity:
4) Safety factors:
5) Diversity:
6) Existing limitations:
7) Other:
8) Other:
c. Summary Table

<table>
<thead>
<tr>
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<th>Air</th>
<th>Water</th>
<th>Motors</th>
<th>Pan Heater</th>
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<tr>
<td>CFM</td>
<td>EAT DB °F</td>
<td>EAT WB °F</td>
<td>GPM</td>
<td>EWT °F</td>
</tr>
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</tr>
</tbody>
</table>

8. Maintenance considerations (describe how the design and construction documents will respond to the PRs):
   a. Anticipated service life of equipment (including existing)
   b. Logistics of replacing large components
   c. Accessibility for cleaning, lubrication, adjustment, monitoring condition, replacement
      1) Pumps
      2) Tube pull
      3) Pipe header components
      4) Filters & strainers
      5) Air vents
      6) Control valves
      7) Meters
      8) Chiller package controls
      9) Oil heaters
   d. Other components

9. Operational considerations (such as safeties). Describe how the design will respond to the owner’s needs (PR):
   a.
   b.

O. Refrigerant Leak Containment and Ventilation

1. Approach: Discuss the rational behind the approach taken to refrigerant leak containment and ventilation in the chiller plant building. Include:
   a. System description (attach system 1-line diagrams):
   b. Describe selection criteria and rationale (with respect to owner requirements, spare capacity, safety factors, existing limitations, etc), including systems considered &
rejected, used to select this system. If existing equipment is to be used discuss the extent of refurbishment and rational for this:

c. System operation: describe each mode of operation and transitions between modes

d. Rationale for system operation sequences of control for systems, and for typical and special spaces (especially labs)
   1) Safety considerations:
   2) Building and individual space pressurization considerations
      (a) Occupied condition:
      (b) Unoccupied condition:
   3) Equipment protection considerations (i.e. freeze, duct pressure limit):
   4) Operability and maintainability
   5) Other:

N.P. Heating Water System

1. System description (describe existing system and modifications for this project, attach system 1-line diagrams):

2. Describe selection criteria and rationale (with respect to owner requirements, building heating load, spare capacity, safety factors, existing system limitations, etc), including systems considered & rejected, used to select this system. If existing equipment is to be used discuss the extent of refurbishment and rational for this:

3. System operation: describe each mode of operation and transitions between modes
   a. Normal (occupied):
   b. Partial occupancy (nights, holidays, weekends?):
   c. Unoccupied (nights, holidays, weekends?):
   d. Emergency:

4. Rationale for system operation sequences of control
   a. Schedule of building occupancy
   b. Equipment protection considerations (i.e. freeze protection, water treatment, boiler safety controls, etc.)
   c. Energy considerations
   d. Other

5. Heating water distribution system sizing criteria (including pumping)
a. Pipe sizing & velocity criteria

<table>
<thead>
<tr>
<th>Pipe size range</th>
<th>Max velocity (FPM)</th>
<th>Max loss ('HD/100LF)</th>
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</thead>
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<tr>
<td></td>
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</table>

b. Component pressure drops

<table>
<thead>
<tr>
<th>Component</th>
<th>Max velocity (FPM)</th>
<th>Max loss ('HD/100LF)</th>
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</thead>
<tbody>
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</table>

c. Distribution temperature and ΔT.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Supply °F</th>
<th>Return °F</th>
<th>ΔT °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>System (Chillers)</td>
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<tr>
<td>AHUs</td>
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<td></td>
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<tr>
<td>Terminal Units</td>
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|                |           |           |       |

d. Pumps

1) Discuss rationale for selecting this style or type of equipment:

2) Describe criteria and rationale used to size and select the equipment, and to schedule its scheduled capacity and TAB settings:

   (a) Owner requirements:
   (b) Facility heating load:
   (c) Spare capacity:
   (d) Safety factors:
   (e) Diversity:
   (f) Existing limitations:
   (g) Other:
   (h) Other:
### Summary Table

<table>
<thead>
<tr>
<th>Pump</th>
<th>Circuit or Equipment served</th>
<th>Sum of Zone Peaks (GPM)</th>
<th>System Peak Schedule</th>
<th>Equipment Schedule</th>
<th>TAB Schedule</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>GPM</td>
<td>Ft. HD.</td>
<td>GPM</td>
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<tr>
<td>Primary (Boiler) Pumps</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Secondary (Distribution) Pumps</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Other</td>
<td></td>
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</tbody>
</table>

6. Boilers
   a. Discuss rationale for selecting this style or type of equipment:
   b. Describe criteria and rationale used to size and select the equipment, and to schedule its scheduled capacity and TAB settings:
      1) Owner requirements:
      2) Facility cooling load:
      3) Spare capacity:
      4) Safety factors:
      5) Diversity:
      6) Existing limitations:
      7) Other:
      8) Other:
   c. Summary Table
7. Maintenance considerations (describe how the design and construction documents will respond to the PRs):
   a. Anticipated service life of equipment (including existing)
   b. Logistics of replacing large components
   c. Accessibility for cleaning, lubrication, adjustment, monitoring condition, replacement
      1) Pumps
      2) Tube pull
      3) Pipe header components
      4) Filters & strainers
      5) Air vents
      6) Control valves
      7) Meters
      8) Boiler package controls
   d. Other components

8. Operational considerations (such as safeties). Describe how the design will respond to the owner’s needs (PR):
   a.
   b.

Q. Air Handling Systems
   1. Approach: Discuss the rational behind the approach taken to heating, cooling, and ventilating the project:
      a. New chiller room:
      b. Existing mechanical space (old chiller room):
      c. Hazardous materials storage rooms:
      d. Maintenance stores and work areas:
      e. Other
   2. Specific systems (supply, return and exhaust), description for each system:
a. System description (describe existing system and modifications for this project, attach system 1-line diagrams):

b. Describe selection criteria and rationale (with respect to owner requirements, spare capacity, safety factors, existing limitations, etc), including systems considered & rejected, used to select this system. If existing equipment is to be used discuss the extent of refurbishment and rational for this:

c. System operation: describe each mode of operation and transitions between modes
   1) Normal (occupied)
   2) Unoccupied (nights, holidays, weekends?)
   3) Emergency (refrigerant rupture)
   4) Describe how minimum outside airflow rate will be maintained

d. Rationale for system operation sequences of control for systems, and for typical and special spaces (especially labs)
   1) Safety considerations:
   2) Building and individual space pressurization considerations
      (a) Occupied condition:
      (b) Unoccupied condition:
   3) Comfort considerations:
   4) Energy considerations:
   5) Equipment protection considerations (i.e. freeze, duct pressure limit):
   6) Operability and maintainability
   7) Other:

e. Sizing criteria
   1) Duct sizing

<table>
<thead>
<tr>
<th>Duct Type</th>
<th>Velocity (FPM)</th>
<th>Loss (In. /100’)</th>
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<tr>
<td>Medium Pressure</td>
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<td>Acoustically Lined</td>
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<tr>
<td>Unlined</td>
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</tbody>
</table>

   2) Coil sizing
Basis of Design Documentation Outline

Page 18

Revised 15 December 2005

<table>
<thead>
<tr>
<th>Coil Type</th>
<th>Air Side</th>
<th>Water Side</th>
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<tr>
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<td>Max FPM</td>
<td>Max ΔP</td>
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<tr>
<td>Cooling</td>
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3) Other Component pressure drops

<table>
<thead>
<tr>
<th>Component</th>
<th>Velocity (FPM)</th>
<th>ΔP “WC</th>
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<tbody>
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</table>

4) Ventilation rate (describe how minimum outside airflow rate will be maintained, and how this relates to the volume of refrigerant contained in the machines).

5) Duct construction and routing

f. Capacity

1) Fan capacity

<table>
<thead>
<tr>
<th>Fan</th>
<th>Sum of Zone Peaks (CFM)</th>
<th>System Peak Schedule</th>
<th>Equipment Schedule</th>
<th>TAB Schedule</th>
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<tbody>
<tr>
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<td>CFM “ WC</td>
<td>CFM “ WC</td>
<td>CFM “ WC</td>
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<tr>
<td>Supply</td>
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<tr>
<td>Exh./Ret.</td>
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</table>

(a) Describe criteria and rationale for scheduled capacities (with respect to owner requirements, spare capacity, safety factors, diversity existing limitations, etc) used to determine scheduled capacity for equipment and balancing:

(b) Discuss rationale for selecting this style or type of equipment if new, or continuing to use existing equipment. If existing equipment is to be used discuss the extent of refurbishment and rational for this:

2) Heating coil capacity (AHU & Terminal units)

(a) Scheduled Airflow

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Total CFM</th>
<th>Min OA CFM</th>
<th>% OA</th>
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</table>
(b) Scheduled Coil Capacity

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<td>FPM</td>
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1) Describe selection criteria and rationale (with respect to owner requirements, spare capacity, safety factors, diversity existing limitations, etc) used to determine scheduled capacity for equipment and balancing:

2) Discuss rationale for selecting this style or type of equipment if new, or continuing to use existing equipment. If existing equipment is to be used discuss the extent of refurbishment and rational for this:

3) Cooling coil capacity

(a) Scheduled Airflow

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<tr>
<th>Schedule</th>
<th>Total CFM</th>
<th>Min OA CFM</th>
<th>% OA</th>
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(b) Scheduled Coil Capacity

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<th>Water</th>
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<td>Equip</td>
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<tr>
<td>TAB</td>
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</tbody>
</table>

1) Describe selection criteria and rationale (with respect to owner requirements, spare capacity, safety factors, diversity existing limitations, etc) used to determine scheduled capacity for equipment and balancing:

2) Discuss rationale for selecting this style or type of equipment if new, or continuing to use existing equipment. If existing equipment is to be used discuss the extent of refurbishment and rational for this:

g. Maintenance considerations (describe how the design and construction documents will respond to the PRs:)

1) Anticipated service life of equipment:
2) Logistics of replacing large components:
3) Accessibility for cleaning, lubrication, adjustment, monitoring condition, replacement
   (a) Coils
   (b) Filters
   (c) Fan wheels
   (d) Motors
   (e) Outside air louvers and screens
   (f) Control dampers
   (g) Other control components
   h. Operational considerations (such as safeties). Describe how the design will respond to the owner’s needs (PR):
      1)
      2)

3. Repeat for each system

R. HVAC Control System

1. System description
   a. Describe existing system and modifications for this project, attach system 1-line diagrams:
   b. Describe interface of new equipment and sequences of operation with existing:

2. Peripheral components or ancillary systems (fire alarm system, security systems, electrical controls, chiller package controls, etc.)
   a. List and describe peripheral components and ancillary systems that the HVAC DDC system interfaces with:
   b. List and describe sequences of operation for DDC and peripheral/ancillary systems interfaces:

3. Describe selection criteria and rationale (with respect to owner requirements, spare capacity, safety factors, existing system limitations, etc), including systems considered & rejected, used to select this system. If existing equipment is to be used discuss the extent of refurbishment and rational for this:

4. Component selection criteria
   a. Control valve sizing
   b. Control damper sizing
   c. Sensor accuracy & repeatability
   d. Sensor function & locations

5. Operations considerations (describe how the design and construction documents will respond to the PRs):
   a. Training needs of staff on new equipment
b. Stability and reliability of system

c. Ease of operator interface

1) Current operating condition:
   (a) Information to be provided
   (b) Format

2) Setpoint indication and modification

3) Trend logging and reporting capabilities

4) Backup database to removable media

5) Schedule modifications

6) Sequence of control modifications

6. Maintenance considerations (describe how the design and construction documents will respond to the PRs):

   a. Anticipated service life of equipment
   b. System complexity & availability of staff to maintain systems
   c. Accessibility for cleaning, lubrication, adjustment, monitoring condition, replacement

7. Intersystem Control Diagrams: List intersystem control diagrams, wiring diagrams and sequences of operation that will be provided to facilitate operations and maintenance of the integrated systems

8. Operational considerations (such as safeties). Describe how the design will respond to the owner’s needs (PR):

S. HVAC System Load Calculations

1. Insert load calculations:

T. Other Equipment and Systems Criteria

1. **Gauges and monitoring equipment.** Indicate standard and special locations for meters, thermometers, gauges, P/T taps, etc. Discuss rational and indicate owner preferences.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Point of use / location</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

2. **Particular or special materials and Methods.** Document the use of any particular or special materials or methods, selected due to owner or designer preference or special project requirements. Discuss the rational behind their selection.

   a. Material or method:

      1) Description of unique properties:
2) Rationale:
   
b. Repeat for all particular or special materials and Methods

U. Electrical Systems

1. Discuss issues and criteria for building and equipment power quality, power factors and other fundamental electrical characteristics. Include:
   
a. An assessment of current building loads and capacities relative to project needs.
b. Power Quality: Describe criteria, current conditions and projected impacts/conditions resulting from the proposed changes to the electrical systems.
c. A discussion of maintenance and operational issues.
d. Future needs: Adaptability and flexibility to meet growth in loads
e. Construction phasing

2. Describe existing system and modifications for this project, attach system 1-line diagrams if appropriate:
   
a. Describe interface of new equipment and sequences of operation with existing:
b. Peripheral components or ancillary systems (fire alarm system, security systems, DDC controls, etc.)

3. Describe selection criteria and rationale (with respect to owner requirements, spare capacity, safety factors, existing system limitations, etc), including systems considered & rejected, used to select this system. If existing equipment is to be used discuss the extent of refurbishment and rational for this:

4. Operations considerations (describe how the design and construction documents will respond to the PRs:
   
a. Training needs of staff on new equipment
b. Stability and reliability of system

5. Maintenance considerations (describe how the design and construction documents will respond to the PRs:
   
a. Anticipated service life of equipment
b. System complexity & availability of staff to maintain systems
c. Accessibility for cleaning, lubrication, adjustment, monitoring condition, replacement
d. List intersystem control diagrams, wiring diagrams and sequences of operation that will be provided to facilitate operations and maintenance of the integrated systems:
e. Provisions for refrigerant handling/recovery (equipment, training)
APPENDIX F
ISSUE REPORT FORM

Renovation Project Master Commissioning Plan

Issue Report Form

<table>
<thead>
<tr>
<th>Project Name:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Test #:</td>
<td>Date: Issue Report #:</td>
</tr>
<tr>
<td>Equipment:</td>
<td>Location:</td>
</tr>
</tbody>
</table>

PART 1: Issue Report (to be completed at the time of observation, by observer)

Observation (describe Issue):

Apparent Cause/Corrective Action:

Avoided Costs Estimate:

Apparent Responsible Parties:

Target Correction Date: Retest Date:

Observer Name/Signature: Owner’s Witness Name/Signature:

PART 2: Corrective Action (by party making correction)

Diagnosis & Corrective Action Taken (describe):

The above listed corrective action(s) have been completed and proven effective:

Person making correction:

<table>
<thead>
<tr>
<th>Company</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
</table>

Retest Date: Results:
### APPENDIX G

**ISSUE TRACKING LOG**

Renovation Project Master Commissioning Plan

<table>
<thead>
<tr>
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<th>Date Reported</th>
<th>Action by:</th>
<th>Action due date:</th>
<th>Status</th>
<th>Short Title</th>
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<th>Description</th>
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## Design Review Comment Resolution Form

**Renovation Project Master Commissioning Plan**

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APPENDIX I
SUBMITTAL REVIEW COMMENT RESOLUTION FORM

Renovation Project Master Commissioning Plan

Submittal Review Comment Resolution Form

<table>
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<tr>
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<tr>
<td>Reviewer:</td>
<td>Submittal #:</td>
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<tr>
<td>Organization:</td>
<td>Phone:</td>
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Status Codes: **NEN** = No exceptions noted, **MCN** = Make corrections noted (resubmit for record), **SSI** = Submit specified items, **C&R** = Correct and resubmit, **REJ** = Rejected

<table>
<thead>
<tr>
<th>Item #</th>
<th>Reference</th>
<th>Status</th>
<th>Comment (by reviewer)</th>
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APPENDIX J
LESSONS LEARNED

Renovation Project Master Commissioning Plan

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<td>Lessons Learned Meeting Agenda</td>
</tr>
<tr>
<td>J.2</td>
<td>Lessons Learned Form</td>
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</tbody>
</table>
APPENDIX J.1
LESSONS LEARNED MEETING AGENDA

Renovation Project Master Commissioning Plan

Explanatory Notes: The following agenda guides the discussion of lessons learned on a project. The Lessons Learned meeting should be held within one year of project construction completion.

Attendees should include the design professionals, contractors, Commissioning Authority, and UT personnel.

The key to the success of these lessons learned meetings is that a third party be the facilitator. The primary reason for this is that anyone involved in the project or facility will be biased and will tend to want to deflect criticism from themselves.

I Meeting Purpose
   A. Continuous improvement
      1. Project delivery process
      2. Commissioning process

II Communications
   A. What worked well?
   B. What needs improvement?

III Schedule Control
   A. What worked well?
   B. What needs improvement?

IV Cost Control
   A. What worked well?
   B. What needs improvement?

V Operational Quality
   A. What worked well?
   B. What needs improvement?

VI Follow-up Activities
### APPENDIX J.2
### LESSONS LEARNED FORM

#### Renovation Project Master Commissioning Plan

Explanatory Notes: As lessons learned are identified and confirmed for action during the Lessons Learned Meeting, record the issue on this form and assign the issue for action. The individual assigned should fill in sections VI, VII, VIII, and IX.

<table>
<thead>
<tr>
<th>I</th>
<th>Project: _______________________________</th>
<th>Lesson #: ________</th>
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<tr>
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<td>Lesson Learned Short Title: ____________</td>
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<tr>
<td>III</td>
<td>Action by: ____________________________</td>
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<tr>
<td>IV</td>
<td>Lesson Learned Description:</td>
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| V | Action Recommended: |

| VI | Action Taken: |

| VII| Action Date: __________________________ |

| VIII| Steps Taken to Incorporate in UT Standards: |

| IX | Follow-up Activities: |
# APPENDIX K
## TASKS

Renovation Project Model Commissioning Plan

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<th>APPENDIX #</th>
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<td>K.3</td>
<td>TEAM RESPONSIBILITIES</td>
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