Basis of Design

This section applies to commissioning of building mechanical systems.

Background

- The purpose of commissioning is to assure the Owner that the facilities are operating at optimum performance levels according to building-program established parameters.

- New facilities have become much more complex, requiring that new methods of start-up and operation be employed to assure that each facility will function as intended.

- There are many critical participants involved with a comprehensive building commissioning program. The obvious participants are the Contractors, Consultants, and the Owner. Additional specialists include a third party Commissioning Agent who is engaged directly by the Owner, and the Test Engineer who will be a member of the prime Contractor’s team. Whereas, by contract, each will have clearly defined individual responsibilities, overall both become the essence of the final quality assurance program. The underlying objective is to deliver a fully operational facility that operates in accordance with the design intent.

Design Criteria

- Generally, for projects with a maximum allowable construction cost (MACC) exceeding $3 million, the UW will hire a Commissioning Agent. This will be a firm skilled in commissioning facilities of the type represented by the specific project. In this situation, the firm will be referred to as the Commissioning Agent. The Commissioning Agent will be hired prior to construction to be available to work with the Design Team and Contractor. In some cases the Commissioning Agent may be hired during design to contribute expert advice before the project is bid. UW Environmental Health and Safety shall serve as the commissioning agent for fire sprinkler systems. Commissioning of the life safety systems shall be coordinated with and approved by the UW Environmental Health and Safety.

- The specific duties of the Commissioning Agent are:
  1) Review the Contractor's systems start-up plans.
  2) Review the Contractor's equipment and component test procedures.
  3) Review the Contractor's systems and inter-systems functional performance test procedures.
  4) Witness, verify and approve satisfactory completion of equipment and component tests and systems and inter-systems functional performance tests.
  5) Review and approve specified documentation.
  6) When testing, adjusting and balancing (TAB) work is contracted separately by the Owner, coordinate the TAB firm's participation in the project.
  7) When commissioning has been successfully completed, recommend final acceptance to the Owner.
  8) Work with design consultant on developing FPT criteria to be implemented in the design document. Test Engineer will develop final FPT based on the criteria outlined in the design document.

- Generally, for projects with a MACC exceeding $3 million, the contract documents will require the prime Contractor to engage a Test Engineer to organize, schedule, and conduct all equipment and apparatus tests and prepare and perform all system functional performance tests. This organizing, scheduling and testing will be presented to the Commissioning Agent and UW Environmental Health and Safety for fire/life safety projects for review and approval.
The primary roles of the Test Engineer are to develop appropriate test procedures for all equipment/systems being tested, complying with the manufacturer’s standards and procedures, and to ensure that all is successfully completed within the contract completion period.

The specific duties of the Test Engineer are as follows:

1) Develop test procedures and forms for documentation of all equipment tests, system functional tests, and cross system functional tests. Test procedures shall be in accordance with equipment manufacturer's recommendations, where applicable. Test procedures shall fully describe system configuration and steps required for each test; appropriately documented so that another party can repeat the tests with virtually identical results.

2) Develop schedules for all testing; integrate testing into the master construction activity schedule; and coordinate all subcontractor testing.

3) Review and approve all other functional performance tests, results, and documentation required by the contract documents; for all equipment and systems, as performed by subcontractors, vendors, and manufacturer's representatives.

4) Submit test procedure schedule, procedures, forms, and other documentation to the Commissioning Agent and Owner for approval in accordance with the Commissioning Plan.

5) Coordinate directly with each subcontractor on the project specific to their responsibilities and contractual obligations.

6) Provide qualified personnel for participation in commissioning tests, including seasonal testing required after the initial commissioning.

7) Provide engineering and technical expertise to oversee and direct the correction of deficiencies found during the commissioning process.

8) Observe the start-up and initial testing of equipment by the Contractor and subcontractors, and then all final tests of equipment and systems.

9) Manage all cross system testing such as HVAC, building automation, fire alarm, emergency power, life safety, elevators, etc.

10) Note any inconsistencies or deficiencies in system operations and enforce system compliance or recommend to the Architect modifications to system design which will enhance system performance.

11) Coordinate the required A/E, Commissioning Agent, and Owner testing participation and approval procedures, after verifying that pretests have been satisfactorily conducted and final tests are ready to be performed.

12) In the event that a functional test fails, the cause of failure shall be determined and rectified as soon as possible, and then retested. If more than three functional tests of the same system(s) are required, the Contractor shall reimburse all associated costs for the extraordinary participation of the A/E, Commissioning Agent, and Owner's staff, as required by the particular test being performed.

13) Review operation and maintenance information and as-built drawings provided by the various subcontractors and vendors for verification, organization, and distribution.

14) Obtain all documentation from tests and assemble a final test report to be submitted to the Architect and the Commissioning Agent for approval.

15) Oversee and/or provide training for the systems specified in the division with coordination by the Divisions 15 and 16 subcontractors.

16) Update Basis of Design by Owners representative.
For projects with a MACC less than $3 million the UW will hire a Commissioning Agent to perform the duties that would be performed by the Test Engineer. The Commissioning Agent may be hired prior to construction to be available to work with the Design Team and Contractor (Please consult with Engineering Services at early design phases). The Commissioning Agent can contribute expert advice before the project is bid.

For projects with a MACC less than $3 million, it may not be necessary to require the prime Contractor to engage a Test Engineer. The scope of commissioning and the extent of commissioning requirements may be reduced as may be appropriate to the complexity and sophistication of the specific project. These decisions must be made by the Consultant and the University, via specific discussion of the commissioning program, and all related decisions and commitments made prior to the end of the design development phase.

Even though a Test Engineer may not be required on projects with a MACC less than $3 million, commissioning requirements for the project will still be incorporated into the contract documents. It shall also be required that the prime Contractor designate, in writing, a member of the construction team to be responsible for the commissioning program.

For all projects a critical requirement for the prime and subcontractors is development of the comprehensive test procedures for equipment and systems. This test is based on the operating criteria, test parameters, and acceptable results required. Many contractors have not had experience in this area. Therefore, someone who specializes (or has had experience) in development of test procedures is required.

The University has developed a library of test procedures for the range of equipment and systems it has commissioned. To a degree, there is a somewhat generic quality regarding test procedures for common equipment and systems. However, in every instance, such procedures must be carefully reviewed and adapted to the unique characteristics and design conditions of the project.

The University will make this material available to consultants and contractors for reference during design and construction. Doing so will help to reduce the time required for such development, develop more consistent testing/commissioning, and gradually improve the quality of the program.

Design Evaluation

The following information is required to evaluate the design:

- **Schematic Design Phase:** Provide a list of systems and equipment to be commissioned.
- **Design Development Phase:** Provide a preliminary scope of work description for systems and equipment to be commissioned.
- **Construction Document Phase:** Provide a final scope of work description for systems and equipment to be commissioned. Provide final design commissioning documents.

Construction Submittals

- **Preliminary submittal**
  a) Commissioning plan
  b) Basis of Design documentation
  c) Sample installation audit forms
  d) Draft startup plan
  e) Draft commissioning schedule
  f) Draft functional performance test procedures
• Final submittal
  a) Commissioning plan
  b) Basis of Design documentation
  c) Installation audit forms
  d) Startup plan and startup forms
  e) Functional performance tests
  f) Commissioning progress reports
  g) Commissioning issues matrix
  h) Commissioning meeting minutes
  i) O&M preliminary review
  j) Owner Training Plan
  k) Final Commissioning Report

END OF DESIGN GUIDE SECTION