

Understanding the Basic Process: General Testing Guidelines

Guideline 1

CLARITY: Make sure that anyone with a reasonable amount of experience can understand and perform the tests.

Guideline 2

ACCURACY: The tests should follow the approved sequences of operation. When they deviate or assumptions are being made, a note should say so – right on the test procedure form.

Guideline 3

FLEXIBILITY: If, during testing, it is discovered that there is a deviation from the approved sequences, testing may continue depending on the nature of the deviation. For example, if the sequences state the building should occupy at 0600, but the contractor has programmed the system to start at 0700 based on experience with the Owner, the test can proceed, but a follow-up note should be distributed.

Guideline 4

SAFETY: The contracting team should review the tests for accuracy, and for safety of equipment and personnel. The team should sign a Safety Compliance form indicating their buy-in.

Guideline 5

PREREQUISITES: The team should agree on the prerequisites required prior to starting field testing. These prerequisites should be listed in the Commissioning Plan.

Guideline 6

SCHEDULING: Clearly establish who is performing the tests and when. A breakout schedule should be developed – system-by-system and/or area-by-area – that lists completion dates for start-up, programming, TAB and testing activities.

Guideline 7

COORDINATION: At least one testing kickoff meeting should be held to verify that the contracting team is ready, responsibilities are assigned, and the team understands how the tests are going to be carried out.

What VirtualCx Test Procedures Include:

Custom cover sheet

Customized headers/footers

Table of Contents

Section 1: Introduction – 15-20 pages of guidance and instructions

Section 2: Sequences of Operation, often including BMS drawings

Section 3: Scheduling and Occupancy Tests

Section 4: Graphics, Trends & Alarms Tests

Section 5 - ?: Systems Tests, each with their own section

Duration estimates for each test

Recommended test attendees, listed on each test procedure

List of pre-requisites, required before performing the specific test

Clear instructions on how to perform the test

Comment areas to list issues and assign responsibility

Signature area for test participants

Fully customized tests, adhering to the approved sequences

Samples from...

Section 1: Introduction to Testing

TEST ORGANIZATION

Commissioning tests are generally organized in a manner that follows the natural flow of the commissioning process: inspections and verifications come first, followed by more complex testing.

- A. Introduction – Important instructional information regarding the testing process
- B. Sequences of Operation
- C. Pre-Functional Tests
- D. Functional Tests
- E. Integrated Tests, if applicable
- F. Pull-the-Plug Tests, if applicable
- G. Optional Appendices and Worksheets

See the Section titled “Basic Testing Terminology” for definitions of these terms.

TESTING GOALS

Ease-of-Use

In order for tests to be effectively performed, they need to be easy to understand and be easy to do.

Well Executed

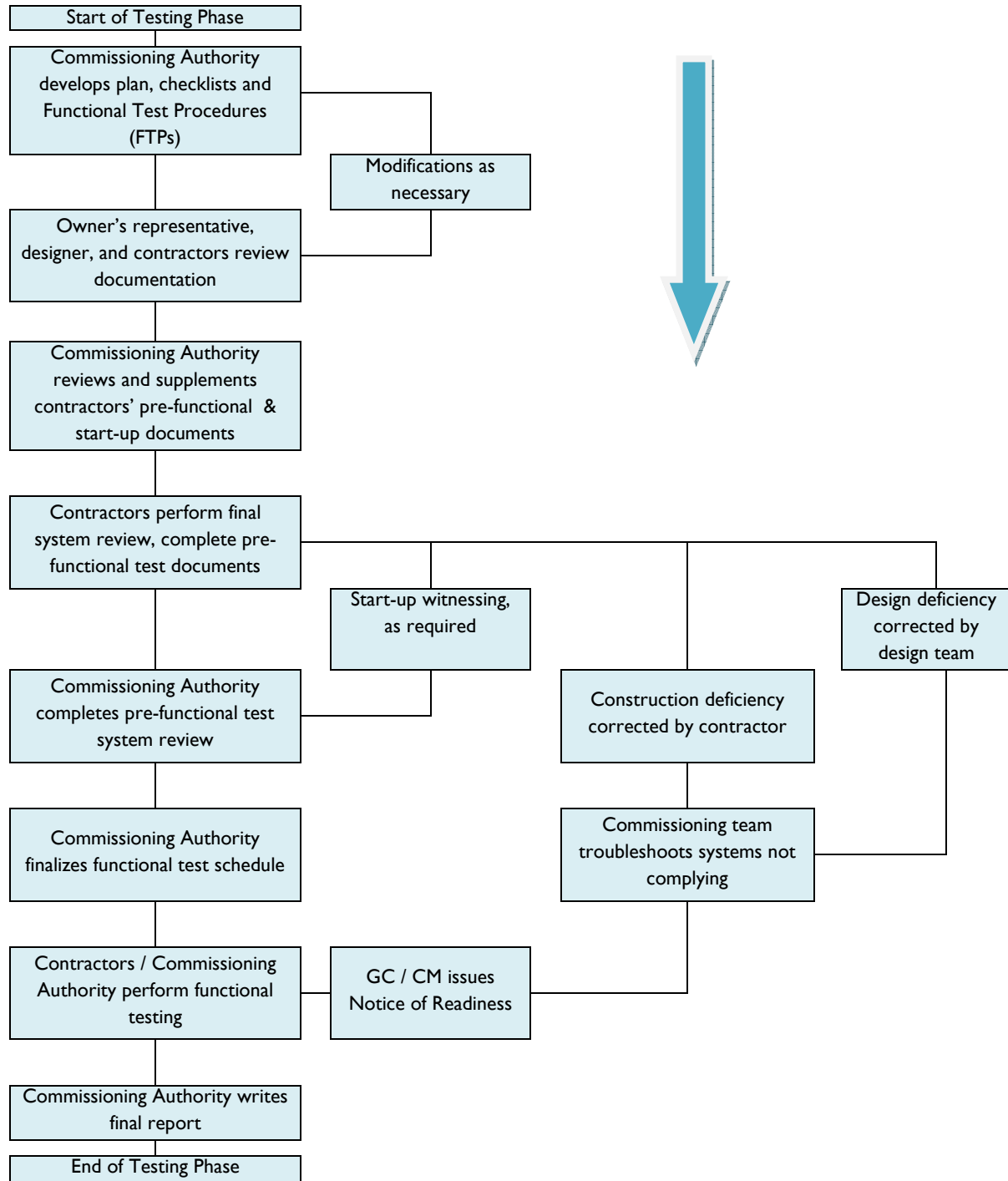
Tests should be sufficiently well written to allow the testing team the time and the space to observe and watch for unusual or improper system behaviors.

The testing teams main goals are to:

- A. Verify that equipment operates per the specified sequence of operation
- B. Verify that controls are tuned to assure responsiveness and stability
- C. Verify that specified setpoints are correctly programmed and are being achieved
- D. Verify that systems perform as intended by the design documents
- E. Verify that recovery from failure is timely and correct

THE TESTING PROCESS

Illustration 1.6A, Testing Phase Flowchart



BASIC TESTING TERMINOLOGY

- A. Pre-Functional Tests (PFT) – these checkouts verify that various components and elements of the systems are ready for functional testing. "Pre" testing indicates BEFORE functional testing. PFTs can include start-up tests/reports, I/O testing forms, calibration worksheets and more. PFTs are sometimes called System Verification Tests.
- B. PFTs are typically performed by the contractor/subcontractor and verified by the CxA via spot-sampling. A 10% sampling rate is typically used, and if a high rate of failure occurs, a second 10% sampling occurs. If there is a continued high rate of failure, 100% sampling occurs, usually at additional cost to the contractor/subcontractor.

The completion of this phase of testing is one of the pre-requisites for Functional Testing.

- C. Functional Test Procedures (FTP) also referred to as Functional Performance Tests (FPTs) - tests that verify that the various installed components/elements work together as a cohesive system. This phase tests system performance as well as the sequences of operations (SOO).
- D. Integrated Testing signifies the testing of various systems, relative to each other. For example, does the fire alarm system provide a *cross-system* signal to shut down the air handler during a fire emergency? While sometimes included as a separately labeled set of tests, Integrated Testing is a built-in component of Functional Testing.
- E. Pull-the-Plug Testing indicates a test or series of tests that verify performance of various systems during a power failure, during emergency power mode, and during a restoration-to-normal power mode. Typically performed in critical applications or on critical systems.
- F. Pass/Fail (P/F) - test results are typically evaluated based on a simple Pass or Fail system. Notes and comments regarding either failures or other relevant information are recorded in the comments section of the test procedures. OPEN issues are typically transferred to and tracked in the Commissioning Issues Log.

IMPACTS, PRECAUTIONS & CONTINGENCIES

- A. Coordination – Do not begin or perform any test that will impact critical operations, unless the test plan has been thoroughly coordinated and approved in advance.
- B. Contingency Plan – When performing critical tests, develop a back-up plan if something goes wrong, and distribute to all team members, for review, prior to beginning the test.
- C. Communication – Verify that all team members understand their role, where they are to be stationed, and that each critical person/team leader can properly communicate (walkie-talkies, cell phone, need a reliable signal). Provide written instructions, as needed.
- D. Red Flag – Depending on the critical nature or size of the test, designate a senior team member exclusively authorized to alarm or 'red flag' the test to immediately cease.
- E. Trending – Trend all tests and print to PDFs. Capture graphic screen shots as needed.