

accordance with these defined needs. The selection of a QA provider should include the same evaluation process the owner would use to select other team members. Qualifications in providing QA services, past performance of projects, cost of services, and availability of the candidate are some of the parameters an owner should investigate and consider when making a selection. Owners may select a member of the design or construction team as the QA provider. While there are exceptions, in general most designers are not comfortable operating and testing assemblies and equipment and most contractors do not have the technical background necessary to evaluate performance. Commissioning requires in-depth technical knowledge of the building envelope and the mechanical, electrical, and plumbing systems and operational and construction experience. This function is best performed by a third party responsible to the owner because political issues often inhibit a member of the design or construction organizations from fulfilling this responsibility.

### **QA3** *Owner's Project Requirements*

The Owner's Project Requirement (OPR) document details the functional requirements of a project and the expectations of how the facility will be used and operated. This includes strategies and recommendations selected from this Guide (see Table 2-5 and Chapters 3 and 4) that will be incorporated into the project, anticipated hours of operation provided by the owner, and basis-of-design assumptions. The OPR document forms the foundation of the team's tasks by defining project and design goals, measurable performance criteria, owner directives, budgets, schedules, and supporting information in a single, concise document. The QA process depends on a clear, concise, and comprehensive OPR document.

Development of the OPR document requires input from all key facility users and operators. The OPR document evolves through each project phase and contains documented decisions made during the design, construction, occupancy, and operation phases. This becomes the primary document for recording success and quality at all phases of the project delivery and throughout the life of the facility. Included in the OPR document are the designers' assumptions, which form the basis of design. The basis of design records the concepts, calculations, decisions, and product selections used to meet the OPRs and to satisfy applicable regulatory requirements, standards, and guidelines.

*Note:* The OPR document remains relatively fixed from its initial development until directed otherwise by the owner.

### **QA4** *Budgets Contained in the OPR Document*

The OPR document is used to define the team's scope in both broad and specific terms. It also defines the QA scope and budgets. The effort and cost associated with designing and constructing an energy-efficient building can be and often are lost because the performance of systems is not verified.

### **QA5** *Design and Construction Schedule*

The inclusion of QA activities in the construction schedule fulfills a critical part of delivering a successful project. Identify the activities and time required for design review and performance verification to minimize time and effort needed to accomplish activities and correct deficiencies.

### **QA6** *Design Review*

A second pair of eyes provided by the CxA/QA provider gives a fresh perspective that allows identification of issues and opportunities to improve the quality of the construction documents with verification that the OPRs are being met. Issues identified can be more easily corrected early in the project, providing potential savings in construction costs and reducing risk to the team. (See "Suggested Commissioning Scope" in Chapter 2 for more detail.)

**QA7** *Defining Quality Assurance at Pre-Bid*

The building industry has traditionally delivered buildings without using a verification process. Changes in traditional design and construction procedures and practices require education of the construction team that explains how the QA process change will affect the various trades bidding the project. It is extremely important that the QA process be reviewed with the bidding contractors to facilitate understanding of and to help minimize fear associated with new practices. Teams who have participated in the Cx process typically appreciate the process because they are able to resolve problems while their manpower and materials are still on the project, significantly reducing delays, callbacks, and associated costs while enhancing their delivery capacity.

**QA8** *Verifying Building Envelope Construction*

The building envelope is a key element of an energy-efficient design. Compromises in assembly performance are common and are caused by a variety of factors that can easily be avoided. Improper placement of insulation, improper sealing or lack of sealing around air barriers, incorrect or poorly performing glazing and fenestration systems, incorrect placement of shading devices, misplacement of daylighting shelves, and misinterpretation of assembly details can significantly compromise the energy performance of the building (see “Cautions” throughout this chapter). The perceived value of the Cx process is that it is an extension of the quality control processes of the designer and contractor as the team works together to produce quality energy-efficient projects.

**QA8A** *Verifying Lighting Construction*

In small retail buildings, lighting plays a significant role in the energy consumption of the building; its impact becomes more pronounced in cooling-dominated climates. Lighting will often be designed after construction of the shell. If possible, the lighting loads should be specified before selection of the HVAC systems in order to select the size and system type for the most efficient and cost-effective approach.

**QA9** *Verifying Electrical and HVAC Systems Construction*

Performance of electrical and HVAC systems are key elements of this Guide. How systems are installed affect how efficiently they can be serviced and how well they will perform. Observations during construction identify problems when they are easy to correct.

**QA10** *Performance Testing*

Performance testing of systems is essential to ensuring that a project following this Guide will actually attain the energy savings that can be expected from the strategies and recommendations contained in this Guide (see “Suggested Commissioning Scope” in Chapter 2 for the CxA/QA provider responsibilities). If the contractors utilize the checklists as intended, functional testing of systems will occur quickly and minor but important issues will need to be resolved to ensure that the building will perform as intended. Owners with operational and maintenance personnel can use the functional testing process as a training tool to educate their staff on how the systems operate as well as for system orientation prior to training.

**QA11** *Substantial Completion*

*Substantial completion* generally means the completion and acceptance of the life safety systems. Contractors, typically, do not test the systems’ performance at substantial completion. While the systems may be operational, they probably are not yet operating as intended. Expected performance can only be accomplished when all systems operate interactively to provide the desired results. As contractors finish their work, they will identify and resolve many performance problems. The CxA/QA provider helps to resolve remaining issues.