Do all of the systems in your facility function as intended?

Should Your Building Be Commissioned?

by Julian Rachman, P.E.

Just two decades ago, building infrastructure systems were simpler. For example, HVAC systems were controlled by pneumatic air, utilizing simple relay logic. Emergency electrical systems — supported by engine generators — were controlled by an automatic transfer switch making use of simple electromechanical relays. These systems were straightforward and simple to test function, but were very limited in scope.

More Compelling and Elaborate Systems

With the prolific use of microprocessors and the benefit of ever-decreasing cost, the infrastructure systems and the systems they support have become more critical and complex. Most modern buildings utilize distributed digital controllers (DDC) to monitor and optimize HVAC system operation. Generators and transfer switches use microprocessors to control engine functions, monitor the utility, predict generator availability, and control power transfers. In addition, these systems are being monitored and their parameters are being measured continuously in real time.

Julian Rachman, P.E.

Uninterruptible Power Systems (UPS) are being widely used to support all types of computer equipment from PCs to main frames. UPSs are mainly made of solid-state components and utilize many batteries. Being the single most complex piece of equipment in an electrical distribution system, it is essential all defects be uncovered early on before a critical load is connected to the UPS system.

The HVAC, electrical, and control systems are interconnected and dependent on each other; a control system receives signals from the electrical system. It determines which chillers, pumps, and air-handling units must start, stop, and lockout under various power conditions. The electrical system then measures system load and sends signals to control the loading parameters of power-generating equipment. Increased load and the requirements for higher reliability dictate engine generators be paralleled with utility and each other.

Construction industry capability is continually tested as the industry becomes more sophisticated. Traditional general contractors capably manage the basic "bricks-and-sticks" aspect of building construction while relying on electrical, mechanical, and controls subcontractors to complete the infrastructure systems. Mechanical and electrical subcontractors bend conduit, pull wire, and install piping or sheet metal. The controls contractor is typically more technically savvy, with knowledge of programming language, and is usually capable of writing code for numerous sequences of operation.

Critical support systems should be tested for compliance with specifications and end user needs.

Both owners and end users ask: "Who knows the whole system?" and "Does everything work as intended?" In response to those questions, the engineer, owner's representative, general contractor, and subcontractor usually reply: "We think everything works like it should." It's a vague response, and not very reassuring to an owner who's invested several million dollars in a project.

Enter Commissioning

The primary purpose for commissioning a facility is to determine and verify that systems and subsystems function as originally intended. Ideally, the entire mechanical/electrical/control and monitoring systems interact as a complete and unified system. If a system fails or malfunctions, commissioning can help determine how significantly one system is affected by another and how cascading failures may be avoided or minimized.

Commissioning can prevent premature failures. The highest failure rate of most mechanical systems occurs at start-up or at the end of their useful life. Testing these systems at their maximum or design capacities during commissioning will stress them fully. Premature failure or an inability to meet design conditions may expose design weaknesses or manufacturing defects.

The most important benefit of commissioning in complex facilities such as a data center or other mission-critical environment is significantly increased reliability. These types of facilities must be continuously available 24/7, so a shutdown due to failure or maintenance is not an option. Commissioning all systems exposes possible failure scenarios and demonstrates how each system reacts to the design intent.

Put It to the Test

One test includes simulating a failure among one of four generators connected to a generator paralleling system. One might expect the unit to automatically shut down, the appropriate circuit breakers to open, and specific loads to instantly shed in order to prevent a cascading system failure. However, commissioning may reveal that the single generator's failure reverses power to the other three functional generators, which causes the emergency system to completely shut down. This results in a loss of backup power to the entire facility.

The only way in which to be assured that a UPS system is assured of carrying the critical load reliably is to thoroughly test and commission it.

Commissioning can also validate all the alarms and monitoring points throughout the system. Complex control systems are custom programmed on each project, and, inevitably, control points are missed, mislabeled, or fail to report into the main terminal monitoring the facility. A complete substantiation should be made of each point. Timing and time stamping are important considerations.

Most large systems typically include thousands of points and numerous parameters that report to them. A major failure could overload or freeze the system. The system's inability to report parameters rapidly enough could result in erratic or missing information, which would render human intervention useless. The main role of the commissioning team is to expose these issues.

> The most important benefit of commissioning in complex facilities such as a data center or other mission-critical environment is significantly increased reliability.

"Green" buildings seeking Leadership in Energy & Environmental Design (LEED program) silver, gold, or platinum certification are mandated by the U.S. Green Building Council to be commissioned.

Dual Purpose

Since each building or facility is unique, the process of commissioning is to test, validate, and "burn in" each subsystem of a complex infrastructure system. This process helps best evaluate the reliability of the sum of its parts.

A side benefit of commissioning is that the owner's personnel may be trained on their actual system without it being "live." They are able to witness, understand, and operate the system. This process helps in every possible scenario.

As facilities and their infrastructure systems continue to evolve, the need for commissioning will become even greater. ■

Julian Rachman is a Professional Engineer and a Principal of DFW Consulting Group. If you would like more information about commissioning, he can be reached at (972) 929-1199.