Why Commissioning for Data Centers MATTERS!

INTRODUCTION

What is Commissioning and Why is it Important for a Data Center Project? What other benefits accrue to a data center owner as a result of Commissioning? This article seeks to answer some of the questions commonly asked by owners who have not been through a commissioning process before. It also provides some background information on electrical testing and load banks.

WHY IS IT SO IMPORTANT?

Commissioning can serve many purposes, but one of its greatest values is a reduction of risk of unplanned outages and downtime. There are many conditions unrelated to design and construction that can lead to an unplanned outage. Commissioning helps to put your data center in the best position to function as it was intended to.

Your data center supports your critical business functions, and it must perform as you expect it to. The consequences of unplanned downtime can be extremely costly to the business. The last thing you want is to discover that critical control or standby systems fail to function when you need them. One of the most effective strategies for avoiding unplanned interruptions resulting from design, construction, installation, and component quality problems is to subject the critical systems to a commissioning process performed by an experienced and qualified Commissioning Agent before the data center "goes live." Without commissioning, systems are almost guaranteed to fail unexpectedly. This sounds like an extreme statement, but ask any design professional who has worked closely with a building owner in the first few months of building's life, after it was turned over as complete by the contractor: something will go wrong that causes a system to fail somewhere. It's nearly the best bet you could make.

WHAT IS COMMISSIONING?

The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) defines Commissioning as "a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria." Commissioning was developed in response to a recognition that the normal design, construction, and systems startup process could not ensure a trouble-free outcome.

Commissioning also provides a means to benchmark a number of operational and maintenance conditions. PUE (Power Usage Effectiveness) can be measured and documented at several operating conditions during commissioning, and an on-going monitoring program can be set up that costs very little to maintain. Electrical test procedures developed for Commissioning can serve as a valuable outline for ongoing electrical maintenance performed by your own maintenance staff, or by a contracted service.

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COMMON QUESTIONS ABOUT THE NEED FOR COMMISSIONING

"We already paid the contractor to perform startup and checkout of all the equipment, why do we need to pay someone else to duplicate this work?"

Commissioning is **not** a duplication of what a contractor does in preparation to turn the facility over to the owner. The reality of construction – all construction, without exception – is that in the rush to complete the project on schedule, people make honest mistakes, defective equipment and components go undetected and untested, motors are accidentally wired to run backwards, connections are not tightened or made at all, control system components are defective or sequences are not fully checked out, controller boards fail, valves stick… the list of real and potential failure conditions is endless. Commissioning provides a systematic and rigorous set of tests tailored to your specific design. It is a process designed to validate performance, and to discover and correct problems before the job is turned over to you. It helps avoid the pain of having to shut down your operating data center to correct these problems – ***after*** they have already caused an unplanned outage.

"The equipment manufacturers are commissioning the equipment at the factory, we don't need to pay to duplicate something we're already paying for!"

Taking this approach puts you at risk. Are you prepared to take that risk? This is one of the more common misconceptions that some owners have. We are not aware of hard data on how often major equipment that supposedly left the factory in perfect operating condition fails to start after installation, but ask any engineering or construction professional who has experience with major construction and you will hear a consistent story. All too often equipment fails to function properly due to faulty control boards, failed relays, or failure of some other component. Equipment is frequently damaged or mishandled in transit, at loading docks, at the rigger's yard, or as it is being installed. This is a very big problem in data center startups, and should not be ignored.

"We just finished a major office building project – it was not commissioned and we had no problems. Why should this project be any different?"

Truth is, the construction process is no different this time, but the sensitivity and criticality of the data center is very different. On your office building project you probably experienced problems that you never even knew about. Why? In buildings that are not "mission critical" many of the failure conditions that occur due to construction problems do not cause major disruptions for the occupants. Most of them go unnoticed. Those that are noticed are not as painfully apparent, disruptive, or costly as they would be for your data center. Data centers are not so forgiving.

"We hired the best contractor available, he has done many projects for us in the past, and he understands how critical this facility is. He knows we need it done right, and has assured us that everything will work."

Some conditions and component problems can not be discovered through normal contracting "due diligence." Even the best contractors and tradesmen make honest mistakes, and all are working under economically competitive pressures to complete work quickly. Large numbers of defective products and components routinely show up on construction sites, and many are not discovered during normal

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startups. Discovering and correcting such conditions during commissioning is not a comment on poor workmanship or care, but rather a thorough and rigorous validation of performance and operation. Problems always exist in constructions, and should be expected as part of the typical construction process. Commissioning helps to discover and correction conditions that will disrupt your business.

"So if we commission our data center, we won't experience any unplanned outages?"

No, there are still conditions that will not be caught by the commissioning process. Commissioning does not test every conceivable scenario, but it does test and verify that the systems will perform as intended under the most likely outage scenarios, as well as during planned switchovers and outages. It allows for the detection and correction of many construction errors, and will highlight design deficiencies as well. Commissioning reduces the total number of potential failures that could occur. Frequently in the course of commissioning, some out-of-the-ordinary condition occurs that reveals vulnerabilities that would have otherwise gone undetected, and allows for correction or mitigation. Remember that most non-construction related unplanned outages are caused by mis-operation (human error) or battery failures (which can be lessened by using a battery monitoring system).

ELECTRICAL TESTING

Third-party electrical testing by a NETA certified testing agency is an important part of the commissioning process. NETA (the International Electrical Testing Association) develops standards for electrical system safety and reliability, and is an accredited developer of standards for the American National Standards Institute (ANSI). The tests described below are considered "Best Practices" for data centers, and for any critical electrical system. Some are safety-driven, as noted. Larger data centers may require more tests than those described. Quoting cost for these tests is possible when the scope of the work is well defined: i.e. the number of components to be tested is known. All of the testing identified is documented by the testing company, and the results are included in the final commissioning report.

Primary Injection Testing of Breakers (400 A and above only):

Verifies that each breaker's trip curve matches the manufacturer's design criteria.

Benefits: Avoids tripping at under- or over-current conditions. Under-current tripping can take systems down when no hazard exists, while over-current tripping can lead to component damage, personal injury, fire, etc.

Wave-form Capture (power quality monitoring):

Tests UPS performance in maintaining a clean output power waveform during switching and load steps, identifying spikes and irregularities. Testing takes place during transfers from utility to generator power, and for step load changes – conditions that introduce wave-form irregularities.

Benefits: Identifies faulty inverters/rectifiers in UPS. Avoids poor quality power due to defective components, or grounding irregularities. When faulty equipment is discovered, manufacturer's may claim that equipment passed factory tests performed prior to shipping.

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Bus & Connection Resistance Testing / Infra-red Scanning:

Tests each bus phase (including neutral) and phase-phase/phase-neutral to detect defects which can lead to abnormal heating of the bus. Infra-red scans of bus connections identify hot spots. All bus connections should be torqued, resistance tested, and documented as part of the electrical contractor's installation procedure.

Transformer Turns Ratio Testing:

Verifies that auxiliary voltage taps provided by the manufacturer meet the specified requirements. Auxiliary taps are used to field-adjust transformer output voltage when incoming utility voltages deviate from desired values.

LOAD BANKS

Load banks are large, portable electric resistance heaters with adjustable output. They are designed and used to create an electrical load for testing generators, UPS and power distribution equipment, and cooling systems before the equipment producing the actual electrical demand is present. Because the initial computer room load is often far below the maximum design load, load banks allow testing of systems and equipment at or near the peak design loads even if the actual design loads will not occur for several years. An outdoor load bank can be used to test the generator alone, while smaller load banks are used inside the building to load the UPS and power distribution equipment, and to simultaneously produce a cooling load for the HVAC equipment.

Load banks are typically rented by the general or electrical contractor. The size and quantity of the load banks required is dependent on the capacity and quantities of equipment to be tested, and also on the sequencing of the testing as it fits into the commissioning schedule. Often, large load banks for generator testing are included in the construction project cost, and permanently installed to permit periodic full-load generator testing throughout the life of the data center. Load banks used in the computer room to simulate IT equipment loads are nearly always rented by the electrical contractor. When the contractor knows that load bank rental is in his scope of work, an allowance can be made to cover the rental cost for equipment and required cabling, plus the labor to move, hook up, and disconnect power. The contractor coordinates final quantities, sizes, and schedule with the Commissioning Agent in the months prior to completion of construction.

Reliable Resources is a multi-disciplinary subject matter expert firm integrating IT consulting with data center facilities planning, evaluation, and design. Reliable Resources focuses solely on data centers.

For more information on how Reliable Resources can help you commission your data center to ensure that it performs the way you expect it to, please contact Reliable Resources at (612) 279-0411.

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