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Integrated System Test



Integrated Systems Testing provides increased assurance for facility owners and operators that the specified equipment has been installed correctly and has been coordinated to work properly with other facility equipment. This testing also provides valuable startup information as a database for future system analysis and equipment modification.

Evaluating the performance of facility equipment and systems under load and during emergency conditions can be considered the most important evaluation facility equipment will ever receive. The tests and inspections conducted during the IST often reveal hidden defects in design, installation and equipment or functional incompatibility issues with specifications or other systems, which can lead to serious system malfunction and down time. Integrated testing will evaluate the impact of system performance on other systems. During the IST, CST will look at interactive impacts for both energy and system reliability. A comprehensive integrated testing protocol will be designed to perform a thorough fail safe process to assure reliability during several modes of operation and load conditions.

Integrated Systems Testing Protocol

The IST protocol includes:

- Testing while under design thermal load
- Mechanical systems operation under several modes of operation
- Under normal power and during emergency power conditions
- Simulated equipment and systems failures
- Heat load capacitance testing
- Measure and log conditions such as temperature and humidity
- Fully coordinated system operations along with electrical systems

The following pages provide two case studies that reveal the value provided through the Integrated System Testing protocol.

Equinix LA3 IBX Data Center

Critical Systems Testing, Inc., (CST) performed mechanical and electrical testing on this critical data center in Los Angeles, CA. in 2006.

This high profile data center, with over 75,000 square feet of conditioned data floor area, is the first in an ongoing series of data centers being commissioned by CST & ERS for the Equinix Company. Shortly after completing the project in mid 2006, the Los Angeles metro area suffered a significant 'brown – out' which resulted in multiple failures in many of the local data centers. The Equinix LA3 IBX Data Center, however, performed flawlessly, with no interruption to services experienced.

Creating a high level of reliability for mission critical facilities requires not only an in-depth knowledge of the mechanical and electrical systems, but a comprehensive method of testing these systems, under load, in all types of failure scenarios. Critical Systems Testing, Inc. in partnership with Electrical Reliability Services has developed an 'Integrated Systems Test' which accomplishes this goal.

Functional testing and inspection of the mechanical and electrical systems revealed many critical flaws which could have caused this facility to fail had they not been identified and remediate. Primary among them was the programming of the automated program which controlled the mechanical systems. During the failure testing under load it was noted that the chillers would shut down in a cascading failure causing complete loss of cooling to the data floor. After analysis it was found that the building automation system was shutting the chillers off during the restart sequence after the simulated loss of utility power test.

This was only one of many conditions found during testing that would have compromised the ability of the facility to operate in a mission critical environment. From generators, to fuel systems, to the central plant, the comprehensive testing and analysis performed by CST and ERS was invaluable to insuring that this facility performed, as designed, under all types of operating conditions. The resulting increased reliability not only reduces operating costs, increases the ability to generate new customers, but significantly reduces the potential exposure to liability resulting from loss of services.

EBay Denver Data Center

Critical Systems Testing, Inc., (CST) performed mechanical and electrical testing on the eBay Denver data center in Englewood, CO. in 2004.

This critical data center, in addition to housing primary servers serving the internet auction functions, was the principle location for the newly acquired pay pal financial servers. The facility was remodeled for eBay, originally designed for another, now defunct, internet services provider that never occupied the facility. The scripting and implementation of the testing procedures provided a set of interesting challenges that revealed unexpected limitations and critical design flaws.

The mechanical systems serving the data floor were comprised of 30 ton split DX Liebert computer room air conditioning (CRAC) units, with pad mounted condensing units in a secure yard. Our original functional tests and subsequent capacitance tests with load banks revealed that the refrigerant charges in the CRAC units were low. Even after additional refrigerant was added, the tested cooling capacity of the CRAC units was well below the engineers design. This fact alone was significant in that it limited the number of servers that this facility could host.

The Integrated Systems Test, which was subsequently performed after the individual equipment and system functional tests, revealed an unexpected flaw in the site design. It was discovered that, during the simulated utility loss test under full electrical load, multiple CRAC unit failures were experienced. Further investigation revealed that when the emergency power generators started, heat plumes created by the discharge air from the cooling systems were causing the CRAC units to fail on high head pressure. This resulting loss of cooling capacity, had it not been found, would have caused catastrophic failures during a utility loss event.

This scenario highlights the critical need for Integrated Systems Testing utilizing load banks on the data floor to simulate a fully occupied and operational data center prior to occupancy. Problems and potential failures may remain undetected, like ticking time bombs, if not fully tested under load during all types of failure scenarios. Increased reliability, enhanced performance and reduced operational expenses is the mission of Critical Systems Testing, Inc.