FST
TECHNICAL SERVICES

Data Center Commissioning Throughout the Lifecycle

A GUIDEBOOK FOR SUCCESS

With global demand for data centers on the rise, choosing the right commissioning agent can make or break a project. FST, a worldwide leader in testing, inspection, certification and engineering solutions, explores the common issues impacting data centers and why it's critical for a trusted third party to be part of the complete lifecycle of commissioning a data center.

LEADING GLOBAL DATA CENTER MARKETS[1]

The Global Demand for Data Centers

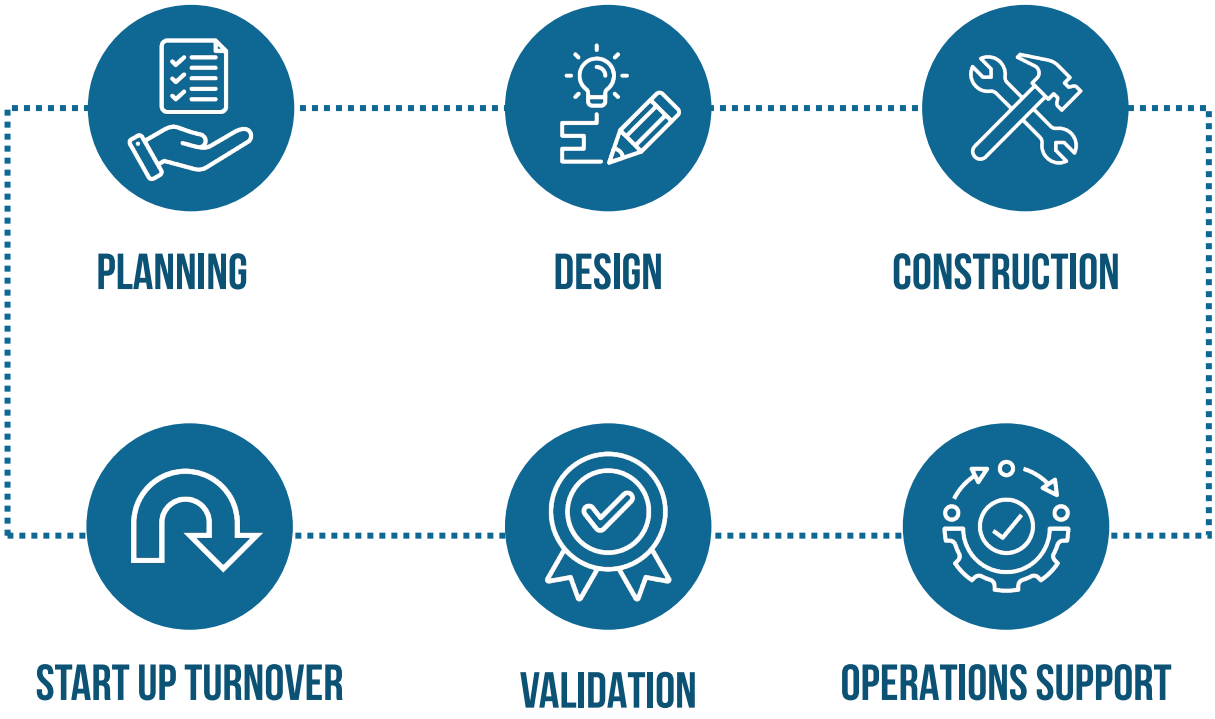
Behind every click, swipe, and share, there's a data center. In the United States, which accounts for roughly 40 percent of the global market, demand for data centers is expected to grow by approximately 10 percent per year until 2030.[1] The rise of artificial intelligence, combined with continued growth in streaming services, gaming, and autonomous vehicles, is anticipated to sustain robust demand for data centers for years to come, placing pressure on owners and operators to significantly expand their capacity to meet tomorrow's need for high-performance computing.

With global competition to build and maintain next-generation data centers on the rise, there is an elevated risk that something could go wrong. Failing to engage a trusted partner early in the process of commissioning a data center can lead to costly mistakes, delays, and equipment issues down the line. These mistakes affect more than your bottom line — they can have a real impact on the safety of your employees and your reputation.

[1] Global Data Center Trends 2023, CBRE, July 14, 2023
[2] Investing in the rising data center economy, McKinsey, January 17, 2023

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." [1]



As a global provider of testing, inspection, certification, and engineering solutions, FST is equipped to assist with existing — and new — smart buildings, including data centers. This includes systems training and commissioning (Cx) services, a systematic process that ensures systems are designed, installed, and operated correctly, safely, and to owners' requirements. While we work effectively with owners and operators throughout the commissioning lifecycle, our experience is best leveraged from Level 0 design stage of a project. This allows us to provide maximum oversight to ensure the successful start-up and ongoing maintenance of our clients' data centers.

[3]ASHRAE Guideline 0-2005

In this guidebook, we explore some of the common issues impacting data centers, and why it's critical for experts like FST to be part of the complete lifecycle of commissioning a data center.

ABOUT FST

Trusted consultants by your side.

FST is a leading provider of testing, inspection, certification, and engineering solutions to a variety of markets across the globe. Our approach is to pull all of our divisions, QA/QC, commissioning, analytical and performance testing requirements into a single integrated package with a single point of responsibility. We have packaged our services to match the lifecycle of the project and enhance the serviceability and lifecycle of the facility.

CASE STUDY

Quality Assurance for a Major Research Institution

An internationally renowned research institution faced challenges in obtaining accurate temperature readings for its data center, a 1-megawatt mobile facility supporting high-performance computing research. After they contracted FST during late-stage Level 4 performance testing, we quickly identified the problem: a vendor initially installed a single point sensor instead of the required averaging sensor. Despite the seemingly well-placed sensor, airflow stratification within the ductwork was to blame for inaccurate temperature measurements. This error led to implementation delays and added expenses, highlighting the critical importance of meticulous commissioning throughout the entire project lifecycle.

The Challenge With Late-Stage Commissioning

Too often, owners engage a third-party commissioning agent late in the process of constructing a data center. This can lead to costly issues that remain hidden until they pose a threat: to a company's equipment, personnel, and reputation. Based on FST's global experience, these are some of the issues we commonly uncover when we are brought in late during the process of commissioning a data center. Engaging the Cx agent early should mitigate these issues by catching them early, so they do not impact construction schedule or operations reliability.

Monitoring gaps and mislabeled equipment

Proper monitoring and reporting are vital for operators to clearly understand their data center's operations. Construction oversights can lead to mislabeled equipment — or worse — making ongoing maintenance and upkeep challenging.

Inadequate temperature separation

Proper hot and cold aisle separation is crucial. Any leakage can result in temperature discrepancies, reducing energy efficiency and compromising server cooling capacity.

Incorrect breaker configuration

It is essential that all breaker settings are configured correctly. Conducting electrical power management system (EPMS) monitoring and coordination studies can reduce the risk of equipment damage and safety issues.

Loose and unanchored equipment

Equipment must be anchored and torqued correctly to prevent safety issues. Furthermore, busbars should be tightened correctly to prevent electrical issues that could compromise the integrity of the equipment and the safety of personnel.

Poorly calibrated sensors

Proper calibration of sensors — especially for temperature and humidity — and accurate scaling of airflow monitoring stations are essential steps to prevent temperature anomalies and wasted energy output.

Lack of systems training

Comprehensive training for operations teams is vital to prevent downtime in data centers, which is often driven by operator errors. FST's hands-on approach stands out by providing systems training in addition to equipment training, which ensures that operations teams understand the system's holistic design and purpose.

The Phases of the Commissioning Process

PROGRAM/PRE-PURCHASE

0 DESIGN

1 FACTORY WITNESS TESTING

2 QA/QC INSTALLATION CHECK

3 WITNESS EQUIPMENT START-UP

4 SYSTEM FUNCTIONAL PERFORMANCE TESTING

5 INTEGRATED SYSTEM TESTING (IST)

\+ POST-OCCUPANCY TRAINING

\+ WARRANTY REVIEW

FST's comprehensive commissioning process offers peace of mind to data center owners, teams, and end users. Beginning an engagement with Level 0 design is the best way to achieve a successful outcome throughout the complete lifecycle of a data center's construction, expansion, or repurposing, ensuring that projects are delivered on schedule and with safety top of mind.

PROGRAM/PRE-PURCHASE

Ensuring a data center meets the owner's needs begins in the programming phase. It is vital to document both the day-one load needs and full load event recovery times so these can be validated later. Being involved before the design phase allows the Cx agent to help the owner properly document their data center requirements. Due to the long lead time of equipment today, it is important to make sure the right equipment is being pre-purchased to meet the owner's reliability, operations, and maintainability needs.

The FST Difference

In today's world of supply chain challenges, careful planning can make all the difference in terms of on-time delivery of critical equipment in a data center's design. We like to be involved early in the process to ensure that owners are properly documenting their data center requirements.

0 DESIGN

Our process continues with discerning the needs of data center owners, determining the required levels of redundancy, and envisioning future expansion plans. In operation since 1984, FST excels at anticipating future growth needs and assess how expandable the systems should be. Additionally, the design process emphasizes the importance of ensuring the maintainability and operability of systems. This includes making provisions for easy maintenance and providing maintenance staff with access to equipment, ensuring that the systems remain efficient and reliable throughout their lifecycle.

The FST Difference

We like to be involved early in the process to ensure that a system's design encompasses all necessary details for commissioning. FST uses a proprietary commissioning software to build and manage our clients' commissioning checklists, ensuring that any issues are meticulously tracked and completed.

1 FACTORY WITNESS TESTING

Conducting meticulous testing and safety checks is a fundamental part of ensuring the reliability and longevity of equipment. This process includes safety point-to-point checks, verifying control valves and dampers, as well as assessing high and low-pressure static safety measures. It's equally important to ensure that sensors are accurately calibrated for temperature and humidity and that metering devices operate correctly. For electrical systems and other critical components, we perform thorough equipment start-up inspections.

The FST Difference

The value of meticulous testing lies in preventing issues from arising on-site, which can lead to significant project schedule disruptions. By addressing and rectifying any problems in the factory, we help minimize potential delays and ensure the project stays on track.

2 QA/QC INSTALLATION CHECK

Energizing equipment prematurely can result in damage, pose hazards to individuals, and potentially lead to costly repairs. Before power, water, or natural gas is connected or energized by an owner's contractors, FST conducts thorough installation inspections of all equipment. These inspections verify the correct placement, ducting, piping details, and adherence to the project's design specifications. The primary goal is to validate that the equipment is installed precisely as intended, prioritizing safety.

3 WITNESS EQUIPMENT START-UP

Conducting meticulous testing and safety checks is a fundamental part of ensuring the reliability and longevity of equipment. This process includes safety point-to-point checks, verifying control valves and dampers, as well as assessing high and low-pressure static safety measures. It's equally important to ensure that sensors are accurately calibrated for temperature and humidity and that metering devices operate correctly. For electrical systems and other critical components, we perform thorough equipment start-up inspections.

The FST Difference

We give extra attention to first-in-kind systems start-ups to ensure the manufacturer's rigorous checks, such as proper lubrication of bearings, free rotation of fans, and correct rotation of fans and pumps. This attention to detail in start-up procedures is crucial for the extended lifespan and optimal performance of the equipment.

4 SYSTEM FUNCTIONAL PERFORMANCE TESTING

We take the reins from the Level 3 start-up team once the equipment manufacturer and controls contractor have given their approval. During Level 4, we perform a comprehensive evaluation of equipment functionality. This involves revisiting Level 3 procedures, such as point-to-point verifications, to ensure valves and dampers operate as intended and sensors are calibrated correctly. Then, we delve into the sequence of operations testing. Our aim is to validate that all equipment operates precisely as designed, responding appropriately to various scenarios, including failure conditions.

5 INTEGRATED SYSTEM TESTING (IST)

Power loss conditions and utility source variations can threaten the performance of a data center. In FST's comprehensive testing approach, we evaluate the intricate interplay of systems within a data center environment. The electrical system interacts with the mechanical system to ensure efficient cooling and uninterrupted operation. To simulate critical loads and assess system performance, we employ in-rack load banks within physical server racks, granting us precise control over heat generation and removal during load step testing. Our testing methodology encompasses both full load simulations, mirroring the data center's design capacity, and specific day 1 load scenarios, acknowledging the gradual ramp-up of operations.

+ POST-OCCUPANCY TRAINING

One of the crucial responsibilities of a Cx agent is to ensure the proper training of operational staff. This entails delivering comprehensive operations and maintenance manuals, guaranteeing that the staff possesses all the necessary information to conduct effective maintenance. We take it one step further: in addition to providing industry-standard equipment training, we also provide comprehensive training on systems and processes. Our goal is to provide clear guidance on equipment operation and maintenance procedures, eliminating confusion and inefficiencies in upkeep tasks.

+ WARRANTY REVIEW

Typically, warranties span a year, with the possibility of additional coverage purchased by the owners. In the post-project phase, we follow industry standards by conducting a monitoring and warranty assessment approximately 10 months after the project turnover. During this critical phase, we comprehensively review systems, including generators and chillers, and engage with operational staff to understand any equipment issues they might be encountering. Our goal is to ensure that any problems are addressed promptly and efficiently while the equipment is still under warranty.

The FST Difference

Having such a centralized reference not only prevents issues like sensors going out of calibration, which can lead to premature equipment failure but also applies to various systems, including servers and building equipment.

Additionally, these manuals include schedules for inspections and maintenance, ensuring that essential tasks are performed on time and that all as-built documentation is readily available, thus contributing to the overall operational efficiency and longevity of the systems.

A Safe and Reliable Data Center Starts with FST

From start to finish, FST is your trusted partner in the design, construction, and maintenance of data centers. Backed by a commitment to collaboration, we work closely with all project stakeholders — from manufacturing representatives to owners' representatives, contractors, construction managers, equipment manufacturers, and operations teams — to ensure that appropriate design standards and installation steps are meticulously followed. When it comes to maintenance, we don't just train on individual components. We emphasize training on entire systems, recognizing the interconnected nature of data center operations.

Understanding our client's needs has been the key to our success since our founding in 1984. We engage with clients early on during the design phase to grasp their long-term plans and operational requirements. In addition to enhancing reliability, this proactive approach results in significant cost savings by avoiding expensive retrofitting and delays. By completing projects on schedule, mitigating equipment failures, and minimizing ramp-up time for additional commissioning teams, we not only ensure the data center's reliability but also optimize efficiency, ultimately protecting equipment and mitigating risks for our clients.

COMMISSIONING CHECKLIST

5 Steps to Ensure a Successful Outcome for Your Data Center

1 Early Engagement

Ensure early involvement of your commissioning agent during the design phase to review plans, specifications, and system requirements. This proactive engagement allows for the identification and resolution of potential issues before they become costly problems during construction.

2 Comprehensive Testing

Conduct thorough testing of all data center systems, including electrical, mechanical, and control systems. This should include not only functional testing but also performance testing to validate that the data center can operate efficiently under various conditions.

3 Documentation and Training

Ensure that all systems and equipment come with comprehensive documentation, including operation and maintenance manuals. Additionally, provide training to the operational staff to ensure they are proficient in the day-to-day operation and maintenance of the system — in addition to the equipment.

4 Issue Resolution

Establish a clear process for promptly identifying and addressing issues that arise during commissioning. This includes tracking and managing issues to resolution, whether they are related to equipment performance, system integration, or compliance with design specifications.

5 Ongoing Monitoring

Implement continuous monitoring and data collection systems to track the performance of critical systems in the data center. Regularly review performance data and conduct periodic assessments to identify any trends or issues that may require corrective action.

Are you ready to begin your commissioning journey today?
Connect with us today to learn more about our expertise.

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MISSION CRITICAL ASSURED

FST Technical Services (FST) was founded in 1984 to serve the needs of the growing, worldwide Semiconductor/Microelectronics and Life Sciences industries. FST's core expertise is in developing technical and logistical solutions for complex needs by continually investing in the most advanced equipment and training.

OUR SERVICES INCLUDE

QA/QC Services

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Training Services

Commissioning Services

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