

“As a trusted partner in changing times, we protect our client’s interests by designing systems solutions that deliver long-term, reliable and cost effective building performance.”

Tom Halpenny, VP Operations and General Manager



## Commissioning Mission Critical Facilities

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## Commissioning Mission Critical Facilities



**Commissioning** is a process that involves the inspection, testing and performance verification of operational components such as instruments, equipment, sub-systems and systems to ensure that they are safe, reliable and are performing as required at the set design conditions.

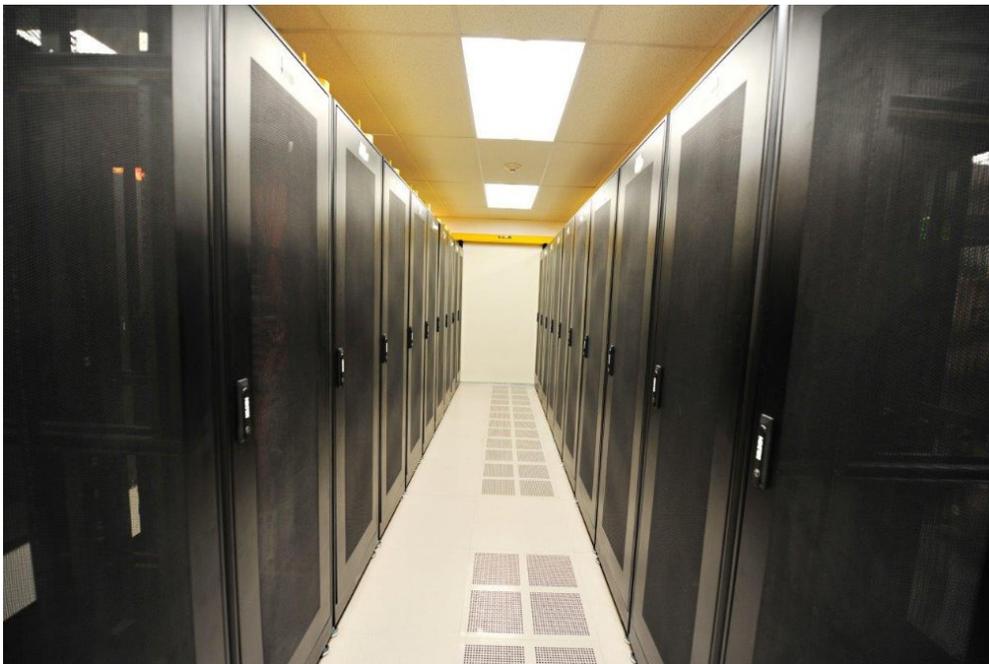
There are industry standards for conducting commissioning activities on facilities. An example of some of the reference entities for commissioning methodologies for buildings and facilities are:

- 1) ASHRAE - American Society of Heating and Air-Conditioning Engineers
- 2) BCxA - Building Commissioning Association
- 3) NETA - National Electrical Testing Association
- 4) Green Building Councils (US or Canada) - Particularly in LEED certified buildings
- 5) The Uptime Institute - Particularly relevant in Tier-certified Data Centers.

## Mission Critical Facilities

These are facilities that are critical in nature to the extent where the failure of part or the complete facility will cause disruption to the business or government operation, or cause danger to the public. Examples are:

- 1) Telecommunication Facilities
- 2) Data Centers
- 3) Transit Facilities
- 4) Traffic Control Centers
- 5) Laboratories
- 6) Defense and Military Facilities



## Commissioning Approach for Mission Critical Facilities

In comparison with the average residential/commercial building commissioning practice, the main objective of commissioning mission critical facilities is to ensure continuous uptime year-long or in other words, 24x7 operation of the facility without unplanned interruption at a specified efficiency. The three most critical systems in a mission critical facility that are typically commissioned thoroughly are:

- 1) Power Systems (Generators, UPS, etc.)
- 2) Cooling Systems (Chillers, Pumps, AHUs, etc.)
- 3) Security Systems (Fire Protection, Controls, etc.)



### So what is different in Mission Critical facilities?

Commissioning mission critical facilities involves:

- 1) Higher witness rates
- 2) Multiple number of tests and iterations (every possible scenario is usually considered)
- 3) Higher level of complexity
- 4) Testing multiple operation, failure and maintenance scenarios

### Overview of Commissioning Levels

- Level 1 – Review and Factory Witness Tests
- Level 2 – Pre-Functional Testing
- Level 3 – Functional Testing
- Level 4 – Individual System Test (IST)
- Level 5 – Integrated Systems Operational Test (ISOT)
- Level 6 – End of Warranty Commissioning (W/CX)

## Level 1 – Review and Factory Witness Tests

1) Review of Pre-Design documents such as Owner Project Requirements (OPRs) which should dictate the Basis of Design (BOD).

2) Review of design documents such as drawings and specifications to ensure that they are reflective of the OPRs. Ensuring that commissioning is taken into consideration in the contract documents and the design is “capable of being fully commissioned”.

3) FWT and FAT (Factory Witness Test and Factory Acceptance Test). It has to be clear if factory testing will be on a sample or all components. Factory testing is an integral part to avoid project delays and contractual risks after equipment delivery to site. Some of the lessons learned from factory testing:

1. Level set expectations
2. Ensure proper test equipment is available in the factory
3. Avoid partial equipment tests
4. Don't be too quick to release equipment with minor deficiencies
5. Don't be afraid to walk away if equipment is not ready
6. Record deficiency list at the factory

## Level 2 – Pre-Functional Testing

Occurs after equipment and components are connected and contractors have completed major works to the extent that components and systems are ready for functional and operational testing. Testing procedures, forms and start-up report templates are reviewed in preparation for functional testing. It is important to ensure that relevant forms are used. Having the right forms in place is critical to the commissioning process. These forms should be checked for accuracy and relevance to the specific system being commissioned. Unfortunately, many times they are simply filed in the project binder and the commissioning moves on.

A component/system pre-functional checklist is an integral part of this phase which confirms that availability and readiness of the component or system for functional commissioning.

### Level 3 – Functional Testing

The intent is to test the sub-systems before they are put together in the overall system. Test all elements of equipment capabilities. Ensure systems and equipment are operating per design requirements; for example, testing a chilled water pump before it is integrated in the chilled water system with chillers and cooling towers.

Level 3 testing is similar to Factory Witness Tests (FWT) previously done at Level 1. The expectation is that test results will be similar. So why repeat them? The answer is that many things could happen between shipping the equipment from the factory and the time it arrives on site. Physical damage is one possibility. Another is damage to internal components from vibration during transportation.

### Level 4 – Individual System Test (IST)

This level of testing should not be confused with the Integrated Systems Operation Test (ISOT). At this level, the purpose is to confirm that components that performed to specification at Level 3 in isolation continue to perform as specified when combined with other components as part of the overall system. The IST process attempts to look at ALL the iterations of maintenance and failure that the facility may experience.

*The opportunity is incredible for the operations group at this Level to get their hands on the equipment and see all the alternative modes of operations of a facility that they may not get to do until an emergency scenario.*

### Level 5 – Integrated Systems Operational Test (ISOT)

At this level, the key operational tests conducted are the:

- 1) “Pull the Plug” test – what happens with complete power loss
- 2) “Black Start” test – starting the facility from complete failure

While some owners believe that these tests are risky, such tests are critical to ensure that all stakeholders, especially the owners, are aware of how the system will behave under a real power cut in the future. The test will give insight into how long it takes to bring the system back into full operation, problems that might occur, bottle necks that might affect the restart of the system, etc. Importantly, this allows owners to evaluate and understand the costs and risks associated with a power loss. For example, consider the costs and risks associated with losing a data center running thousands of ATM machines.

## Level 6 – End of Warranty Commissioning

In essence, this is the last opportunity for the owner to check the system for any defects and claim repairs under the manufacturers' warranty. In addition to that, a review of set points, operating conditions and sequences is conducted to ensure that the facility is being operated as specified and the resulting outputs are as expected or guaranteed by the engineering/contractor/supplier teams.

## Closing Remarks

Commissioning is a key activity in the design/construction of any facility. The level of detail in commissioning will vary depending on the criticality of the facility, client requirements, available funds to conduct commissioning, building codes and requirements, and other project-specific factors. Certainly, when commissioning a nuclear submarine, one would expect that every single component and system will be commissioned. But when 1,000 cars are produced from one production line, one would expect that a sample only is tested or "commissioned". For critical facilities, a data center built to store data might be commissioned differently than a data center built to process the New York Exchange Stock market transactions. There are also other commissioning practices that are implemented in specific projects. One example is seasonal commissioning where equipment and systems are commissioned at different seasons to confirm operational performance (for example, summer vs. winter).

All in all, it is important that owners, engineers, contractors, suppliers and other project stakeholders are aware of the importance of commissioning, plan for it at the early stages of a project, and ensure that commissioning is executed properly during the different stages of the project lifecycle. It is not an activity that ends with project completion; re-commissioning is common in many facilities aiming at continuously evaluating operational efficiency and that the operators are actually operating the facility as specified in the original design, and if not, understand why.

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