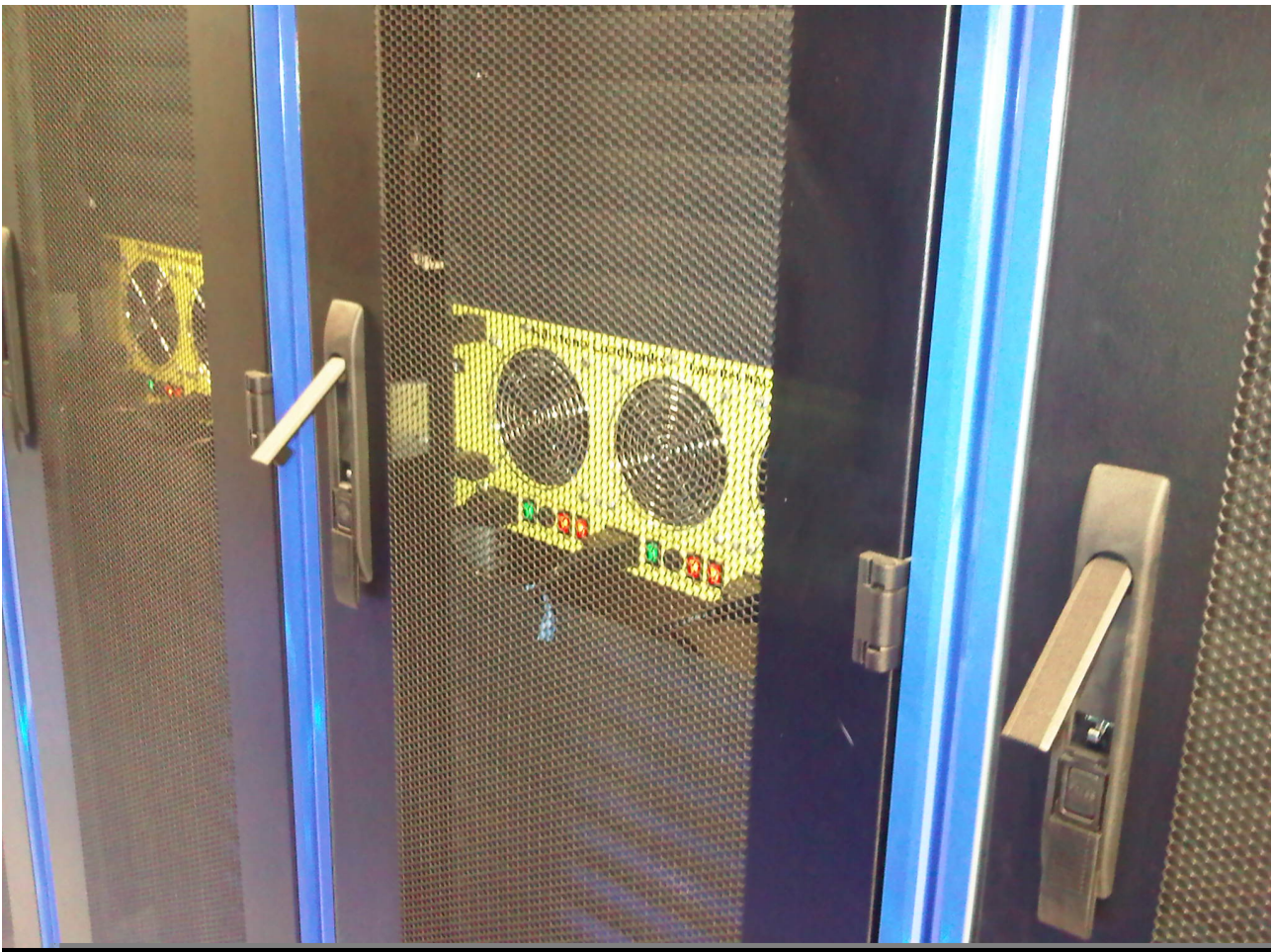


# WHITE PAPER:- Datacenter IST Commissioning

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ISSUED BY

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## 1.0 Executive Summary

This document is presented to discuss the use of convection heater load banks when performing independent Integrated System Testing ( IST ) and Commissioning of a data hall's mechanical and electrical ( M+E ) infrastructure.

The intended audience for this document are datacenter owners, including colocation providers and end users that occupy and use the data hall as tenants.

This white paper uses industry guidelines from organisations such as ASHRAE, UPTIME INSTITUTE and the TIA Standards along with experience from engineers that have conducted many projects for organisations in Media, Telecoms, Banking, and datacenter providers, to provide a rational overview for the benefits of conducting IST Commissioning.

This paper does not consider the wider commissioning issues for areas such as security, fire suppression, management etc.

## 2.0 Introduction

The purpose of stress testing the mechanical and electrical systems under an Integrated System Testing IST Commissioning program is to demonstrate the operation of the datacenter will not be compromised when any expected method of operational failure occurs in the facility.

The performance of the IT space during IST Commissioning should therefore satisfy the original design specification and operational requirements of the data center user or tenant.

The IST Commissioning must be conducted when the data hall is running at its maximum thermal, electrical and environmental conditions.

Such testing cannot be considered once the tenant has installed active IT equipment so commissioning must use server simulator load banks to create an evenly distributed convection heat across the IT space.

Only after establishing these environmental conditions can the failure testing scenarios commence of the installed M+E systems.

The purpose of this paper is to therefore explain the procedures behind and the reasons why IST commissioning will benefit all parties that provide and use a datacenter

### 2.1 Systems to be tested

The mechanical cooling systems typically incorporate: chillers & compressors ( outside the IT space ) that support the air handling units or Computer Room Air-Conditioning ( CRAC ) units ( inside the IT space ).

The electrical systems will incorporate 11KV - 33KV switch gear, Uninterruptible Power Supply ( UPS ) systems of A + B configuration with at least n+1 redundancy for Tier III & IV designs, with Low Voltage distribution boards to provide distribution power points inside the data hall. There will also be a back up generator on site supporting the UPS systems

The M+E systems will be controlled by a BMS ( Building Management System )

**2.2** The **Independent Validation and Commissioning team** provide a vital link between the landlord and all other parties. It is their role to perform the IST program with integrity and at the same time to integrate with the project team so to gain a full understanding of the design and build. This will formulate the required sequence of testing that should be submitted for approval to the project owner at least 2 weeks prior to the testing dates.

### 3.0 The **four stages of testing a datacenter** are:

- Site acceptance testing
- IST Commissioning
- Tier Certification
- Customer acceptance testing

The success in completing each of these stages will define the operation of the datacenter

**3.1 Site acceptance testing** is a pre-requisite of any IST commissioning. Only when all the design and build of the facility systems have been completed can we consider starting the IST commissioning .

It is important to remember that the project time line will never allow for site acceptance testing to replace IST commissioning because the commercial nature of the project dictates each supplier acceptance tests will be separate from another and will not be conditional to integrated operation

**3.2 IST Commissioning** can be performed in two typical scenarios

- Testing the empty space ( prior to deployment of IT equipment cabinets
- Testing the room after in IT racks or cold aisle containment cabinets pods

The advantage of testing the empty space allows the owner to prove full operation before gaining Tier Certification or handing the room over to a tenant. This testing will identify the need to implement remedial works and these issues can be closed before any prospective tenant commits to the space.

The benefit to the tenant of testing the room after the deployment of IT cabinets is to gain confirmation the space will perform to design requirement.

Typical testing requirements for IST Commissioning should include at least:

Mechanical - Establish environmental conditions, with provision for rectification works as required.  
- Conduct full monitoring of temperature and humidity condition performance whilst exerting full load stress testing on to the space to verify the thermal conditions remain within required industry standards

Electrical: - Full load testing of the UPS A & B feeds  
- Infra Red survey's of PDU ( Power Distribution Unit ), PPC ( Precision Power Center ) units  
- Change over testing on full load from A to B supplies  
- Black start generator testing and resulting performance study of the HVAC ( Heat Ventilation Air Conditioning ) system

**3.21** If we consider **testing prior to deployment of IT equipment** the landlord can validate, that the IT space will perform to the intended mechanical and electrical design specification.

This is implemented by the use of **mini-towers** hosting server simulators load banks that are spread across the data hall. The position of the mini-towers next the cold aisle airflow will generate hot thermal air streams similar to a hot aisle when the room is fully populated.

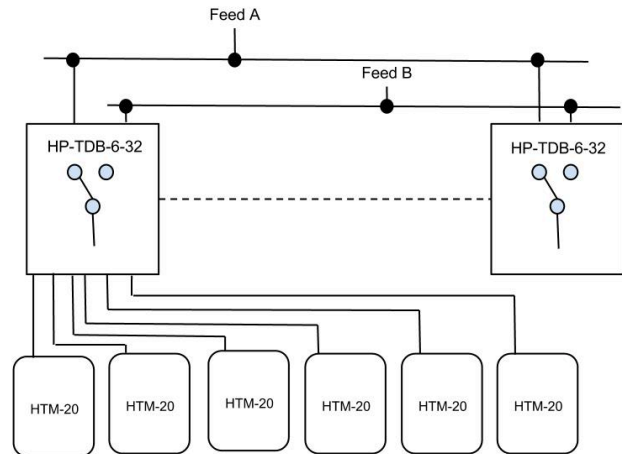
Such mini-towers should also give extreme flexibility of connectivity in the data hall to allow that they can be powered directly from single phase or 3 phase power points installed in the room to provide power to future installed IT racks.



Another important component when testing an empty space is a **temporary distribution board** or TDB as illustrated in the following system diagram.

This is an item that will allow electrical connection to both the A and B UPS feed supply for transient measurement of load transfer testing between the A supply to the B supply.

The TDB will therefore provide synchronized control to all other connected FDB units to allow full load transfer on the system



**3.22** When we consider testing after the tenant has **populated the IT space with cabinets**, which should be planned before deployment of active IT equipment, the tenant can validate the data hall operation prior to the room going live and the room being locked down.

This is also the only time site acceptance testing of a design that implements containment POD cabinets with an integral HAVC system can be completed.

This testing will involve installing an even distribution of 19" rack server simulator load banks into the IT cabinets. The testing will also require the fitting of blanking plates in every cabinet to ensure the thermal performance of the room matches the room design.



These two scenarios ( before and after deployment of IT cabinets ) should be mutually exclusive events so the new tenant will be satisfied the facility meets the design expectations

The client may also want to conduct other testing procedures that may be required for Tier Certification.

**3.3 Tier Certification Testing** of a facility is an independent service conducted by the UPTIME INSTITUTE, who issue a certificate that is coveted throughout the industry as a defining category rating for a datacenter. The inspection process would prove the facility can fully operate during maintenance works is performed on the M+E systems without any downtime of the IT space.

This demonstration whilst specific to Tier Certification will replicate certain parts of the IST Commissioning but due to the time frame and sequence of testing Tier Certification will not necessarily stress the space to the same extent that is performed during IST. The certification will though require the IT Space to be fully loaded at the maximum design rating with the use of server simulator load banks.

### 3.4 Customer Acceptance Testing

Whilst Tier Certification is a valued achievement for colocation providers it is not a true industry standard and tenants frequently have their own acceptance testing criteria that they will want to complete before signing the lease agreement. This will include fire, security, management and facility layouts.

It is also recommended that the landlord requests an advance copy of the tenants testing procedure so the project team can consider the scheduled tests have been previously completed.

#### 4.0 Marketing Data Center IST Commissioning

The ambition to gain a Tier Certification for the facility along with the professional reputation and stature of the colocation provider is obviously the major attraction for any client to consider leasing a data center. This is the reason why investment, design and build of the facility has taken place.

After the successful completion of **Independent IST Commissioning** the facility owner can add to the marketing strategy the following key note points:

##### 4.1 Confidence: The IT space is fully operational under all failure scenarios at full load operation.

This is a very important achievement because the new tenant will probably never populate the room to run at full load capacity, but they will have confidence to implement plans for black start redundancy or future expansion of high density active IT equipment, with the knowledge the landlord is an experience colocation provider.

The IST report will give detailed information, results and analysis

##### 4.2 Tier Certification: The facility is ready to be inspected for Tier Certification

The completed full load IST will form the basis of the Tier Certification inspection process. With suitable planning any issues identified during IST will have been corrected and the facility will gain Tier Certification to the full load design rating. This adds full value to the selling price of the space because the space is offered against the KW rating ( of the power and cooling ) and not the number of occupied cold aisle rows the tenant will use.

##### 4.3 Customer acceptance: The independent commissioning report secures the commitment of the new tenant.

With the report the landlord can demonstrate the acceptance criteria that clients will typically require, thus allow the completion of the long term lease agreement

##### 4.4 Verification:

Future tenant demonstrations of specific operational requirements can be commercially offered with the assurance that the facility will perform as required by the landlord in the clients cabinets prior to installation of active IT equipment.

The successfully completed **IST Commissioning program** is therefore vital to testify the true operation and rating of the facility

#### 5.0 Conclusion

The decision to implement Integrated System Testing for the Mechanical and Electrical systems will be pivotal in the facility acceptance by the end user. The owner will have demonstrated that they have delivered to the highest expected standards and the end user will have the confidence to commit long terms strategy plans for the facility.

This success justifies the investment cost of IST stress testing and is a cost which must be included in the business model of the datacenter.

The options for sourcing the server simulator load bank equipment is available from specialist companies, like Hillstone Products, that can offer rental packages or manufacture for direct sale. The datacenter owner can, under Service Level Agreements with the load bank company, offer load banks as part of the tenant acceptance testing requirements. Thus providing an comprehensive level of service and support to the tenant.

The decision to holding the load banks under a cap-ex budget would be based on analysis of the pending and future datacenter portfolio. Where-as the op-ex budget would be considered for low volume asset ownership.