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The Importance of SAT and IST in mission critical facilities

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SAT and IST refer to Site Acceptance Testing and Integrated Systems Testing respectively.

The typical life cycle duration of a modern data centre through design, implementation and operation is approximately 15 years.

During this time, one of the most important areas is the testing and commissioning programme. Surprisingly though it represents the shortest of time during the data centres life and is often neither thorough nor rigorous enough to ensure that the facility has been both designed and built to provide a stable environment for the IT systems it will host over t

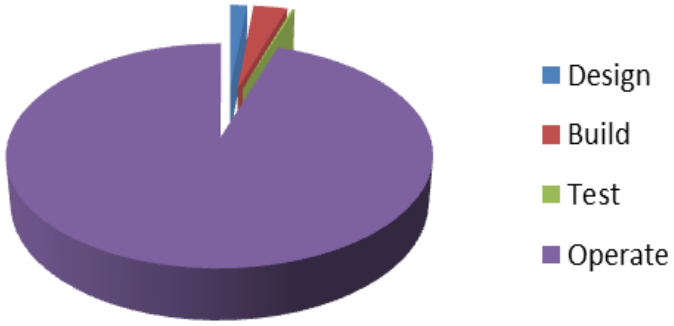

Figure 1: Data centre life cycle stages.

What makes them so important during the end of the build phase of a data centre project?

Compared to most other building environments, critical infrastructures (such as data centres, nuclear power stations & hospital life support systems) once powered up and supporting their mission critical application, will never be intentionally turned off. For some clients, the engineering behind the resilience and redundancy can be referred to as Armageddon planning with the intention for a data centre to be the last thing running no matter the circumstances.

For that reason, the testing phase represents the only opportunity to ensure that the facility is as robust as expected. To make sure the design and construction work deals with a variety of different scenarios and maintains availability. The negative impacts of down-time can be losses in both financial terms and brand reputation. The testing phase gives the owner the safety and knowledge that the facility has been designed and built well and operates to the planned processes of design.

Without a proper SAT and IST how is the following validated?

1. Capacity and Load testing of all systems.
2. System redundancy.
3. Fault resilience and tolerance (to Uptime Tier Relationships, I, II, III and IV).
4. Generators are proven to operation, and ensure function in sufficient time.
5. UPS systems are fully proven to expectation and requirement.
6. Automatic transfer switches (ATS) and static transfer switches(STS) relationships are fully proven to expectation and operation.
7. Cooling system restarts at maximum load and time to bring the temperatures to within SLA (service level agreement).

8. Control system behaviour and expected outcome.
9. Behaviour of systems during seasonal operation.
10. Effect of thermal run away.
11. Integrated testing of the various systems to ensure integrated operation of the facility as a whole.
12. Black-build (full power off and re-start of the facility) operation.
13. DCIM platform is fully integrated and will perform as you expect, alerting, monitoring, predicting.

What is SAT and IST and what does each testing stage represent?

Prior to undertaking SAT and IST it is expected that the basic level of testing and adherence to local and international *(where applicable)* mechanical and electrical systems guidelines has been conducted successfully. Also, a clear and detailed testing and commissioning programme is required.

This combined with detailed test scripts of what, how and where the testing will take place is key to the successful SAT and IST for your data centre. The test procedures and script will normally form part of the sign off with the end user or client. They may also wish to send a representative to witness some of the testing, this could be internal or an appointed specialist consultant.

The SAT procedures should be driven by the vendor and added to by the data centre specialist. The SAT procedures should be similar to the **FAT* (Factory Acceptance Testing)** procedures. This may be seen as repetition and the argument of; 'Isn't just doing the FAT acceptable?' The answer is always NO!

****FAT** - This is the equipment manufacturer (OEM) testing their own equipment in their own factory, in ideal conditions where it is carried out on a daily basis. It is only a test that the equipment operates as standalone basis following its manufacture.*

The SAT tests that the equipment that has been installed correctly and so has its supporting infrastructure. For example the SAT testing of a UPS would include the input/output cabling and batteries not generally present during the FAT, and similarly for a chiller that the pipe work and pump systems function correctly.

The SAT will also test capacity equipment to its designed rating and usually overloading it for a short time.

Capacity equipment refers to items such as a UPS which provides a capacity of power such as 500kW, batteries which provide a run time such as 5mins or CRAH (Computer Room Air Handing) units which provide both a cooling capacity and airflow.

SAT Key Point

- OEM/Vendor driven testing.
- Similar to FATs but at installed location.
- Includes all capacity and switching components.
- Electrical power required.
- Mechanical systems are filled (i.e. chilled water system).

The final stage of testing for a data centre after successfully completing the SATs is the IST. The primary objective for the data centre IST commissioning is to verify the electrical and mechanical systems under full load operating conditions, failure scenarios and maintenance operations, ensure that the data centre is ready for the IT/Server equipment to be installed.

In order to replicate the heat load and airflow created by the servers there are two ways in which this can be achieved, the latter being the preferred, but not always a possible option.

Firstly, where no racks are installed in the white space, floor standing heater load-banks are positioned within the white space and provide the same (Kilowatt) kW output as the design IT load.

The preferred, second option, and one only possible when the IT racks are present, is to install rack mounted 19” heater banks.

As an example - Inside a 100kW data hall the airflow required would be 65,500 l /s or 138,787 CFM.

These ‘sever replicators’ are the closest thing to the real things. However, it is important that not only heat output is replicated but that airflow and thus the delta temperature of the servers, (the temperature of heat across the server) is always accounted for.

Server airflow typically ranges from 45.5 l/s/kW to 75.5 l/s/kW. Typically, airflow of 65.5 l/s/kW would provide a sufficient design basis. Whether it is floor standing load banks or rack mount load banks, both the kW capacity and airflow are important deciders when comparing different types of load banks.

The IST puts the data centre through its paces and this is the ideal opportunity to ensure that everything is right before being handed over to the client – ultimately this is where issues are identified and then there is time to rectify or modify before re-testing.

Sudlows would always recommend a pre-IST where time allows and to give a buffer for corrective actions to be made. Those who work within the data centre industry will understand the tight timescales to get the facility up and running but should also appreciate the importance of thorough testing, as you would rather correct issues before the end user has migrated all there IT equipment over.

IST Key Points

- Focus on the testing of interconnected equipment.
- Resilience and redundancy tests.
- Scenario testing of equipment failure.
- Maximum design load testing on entire infrastructure/distribution paths.
- Concurrent maintainability and fault tolerance testing.
- Mimic actual sever heat/airflow output.

If you would like to know more about critical infrastructure testing or are concerned that your facility has not undergone sufficient testing please contact your local Sudlows office, your authority on critical infrastructure engineering.

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