WHITE PAPER

Next Generation Data Center Infrastructure

ICE Cube™ Modular Data Center Installation Overview and Service Offerings

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ICE Cube Installation Overview

SGI® has designed ICE Cube to arrive fully cabled, labeled, racked and stacked with all server and network equipment installed, tested and production ready. Upon arrival, it can be placed in its desired location, connected to power, and turned on. There is no requirement for additional assembly or hardware installation on site.

SGI utilizes an ISO trailer chassis featuring an "Air-Ride" suspension system, ensuring the maximum safety of the contained system. SGI has shipped fully populated containers from coast to coast in all seasons, and has established a proven and repeatable transportation process that ensures the system arrives ready to "plug and play."

Component Integration Process

ICE Cube containerized infrastructure, and the server, network and storage equipment it houses, is fully integrated at SGI's manufacturing facility. Servers are assembled and pass preliminary functional tests on the assembly line, which includes special fixtures that allow the servers to be run for extended periods without risk of damage. Servers come off the assembly line at a load level dock door specially equipped to handle the integration of servers and other equipment into a fitted out ICE Cube container. Final test and burn-in is completed inside that container. The container is then powered down and prepared for shipment. Upon arrival at the customer site, the container is integrated into the customer's infrastructure.

Installation Considerations

The containers are designed to be waterproof and dustproof, but it is recommended there be a canopy over each container in high solar radiated areas in order to reflect solar radiation and reduce the amount of time the chiller needs to be in operation. Depending on the environmental conditions and server configurations, it is possible to design ICE Cube configurations that operate correctly with elevated termperatures (such as fully mobile configurations), as insulative coatings are available to help reflect a larger amount of solar radiation in mobile deployments.

If the containers are not covered, the HVAC units within the containers can be configured to handle the additional thermal and solar load during extremely hot external ambient temperatures. The anticipated effects of this would require 8-10 tons of added capacity (100K BTUs / hour for the hottest three hours of the day). Operationally, it would likely prove to be lower cost to cover the container with an insulative coating, fabric awning or a simple structure similar to a pole barn to provide shade.

Internal Temperature and Humidity

SGI recommends that the temperature swing inside the container cold aisle / server environment be stabilized to about 5F with an inlet temperature of 75 – 85F. The humidity should be kept at a non-condensing level to maximize cooling efficiency. Our proposed cooling system (pump, compressor, and tower) will meet these operation requirements.

Operating at as high a temperature as possible is recommended to increase the number of free cooling hours per year and reduce condensation issues. There is a complex relationship between inlet water,

air flow, and delta T resulting in the cooling capacity of a given design. SGI normally recommends operating with 65–70 degree F water at 150 GPM and 30 ft of head loss. 55 F at 150–160 GPM and 10–15 F delta T depending on load works well.

Water Connections

Water is usually supplied to the ICE Cube via 2.5" grooved Victaulic connections (http://www.victaulic.com/content/quickvicrigidcoupling.htm), with the stub leaving the container being a male end. A supply and a return line is provided on each side of the container (or end, if so configured). It is recommended that a simple 4" to 2.5" Victaulic "Y" be used about 12' from the container, with the two supply and two return 2.5" hoses going to a 4" feed hose or line. A circuit setter can be placed on the 4" return line to set the flow, if so desired. A 4 or 8 bolt 4" flanged connection is also available as an alternate choice.

Placement

There is ample flexibility with regards to the placement of an ICE Cube, as it can either be left on the chassis it was delivered on (and left mobile) or be removed from wheels once at its destination (landed deployment). When removed from the chassis, ICE Cubes can be stacked more than three high, can be abutted or placed side by side. Service clearance between containers can be less than six feet on sides, requiring power and cooling access. There is a minimum of two feet of clearance required for other sides.

Shakedown Test Process

Once the container's electrical, network and water connections are complete, SGI's installation team runs its verification suite. The verification suite exercise all of the containers compute, electrical, network and cooling functionality. The server population and the drive components in particular are heavily exercised to isolate any potential transportation impacts. During this 2-day shakedown test, the container is closely monitored and all failed components are rapidly repaired to minimize the test time.

Container Stacking

ICE Cube utilizes an ISO standard commercially available 9.5' x 8' x 40' container. SGI intentionally designed the offering such that the roof of the container is clear of obstruction and fully capable of utilizing its stacking container feature. Because of this, SGI is positioned to supply a compelling density multiplier for future expansion of the data center. If installed in a location without overhead height restriction the 9.5' x 8' x 40' containers in our primary product offering can be stacked up to three-high, thus allowing customers to double or triple the per square foot density of the facility over the already industry-leading density of a single ICE Cube.

ICE Cube Professional Services

Modular Data Center Assessment

SGI's Modular Data Center (MDC) assessment includes:

- Planning and programming
- Establishing the MDC infrastructure and operational requirements
- Assess the selected site for MDC infrastructure requirements
- Utility due diligence (as required)
- Civil due diligence (as required)
- Scoping and schematic design
- Develop MDC operational cost analysis
- ROM pricing for infrastructure construction
- Preliminary Implementation Schedule
- Develop customized installation and start up for MDC

At the end of the assessment, SGI delivers:

- A detailed assessment of proposed Mobile Data Center infrastructure site
- Narrative scope of work of site and infrastructure upgrades required to support requirement
- High level schematic design
- Rough order of Magnitude (ROM) pricing for complete solution
- Project schedule

Modular Data Center Infrastructure Construction Service

With a clear understanding of the requirements from the MDC assessment, SGI partners with selected data center construction partners to insure a seamless, coordinated construction process, resulting in flawless deployments.

Modular Data Center Design Services

Many customers require customization of their MDCs access, network or HVAC to meet their specific requirements. SGI's MDC design services allow this flexibility to be incorporated with SGI's industry leading MDC designers. Sample scopes of work include:

- Develop MDC network plan
- Develop MDC server & network layout for optimized power, cooling, performance & cost
- Develop customer specific VERSDA requirements
- Develop customer specific MDC monitoring requirements
- Develop customer specific battery monitoring & operational procedures

ICE Cube Site-Prep Services

If a customer decides not to purchase SGI's Mobile Data Center Construction Services, It is recommended that the ICE Cube site preparation service be purchased to insure a smooth installation process. This service includes a visit to the installation site by both an SGI field service technician and ICE Cube engineer. During their visit they will proceed through the site preparation check list verifying the physical installation path, potential safety issues and all external connections physical locations and capacities.

Modular Data Center Installation Services

SGI's MDC Installation service is designed to insure a flawless installation on an approved site, including:

- Clean MDC exterior
- Move MDC onto pad
- Connect and verify water, power, and network
- Power on monitoring systems
- Power on servers and network
- Verify server / network functionality
- 2-day shakedown testing
- Customer acceptance and hand over

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