

## Are You Considering a Modular Data Center?

Modular data centers are attractive for many reasons. Primarily, they offer data center owners the ultimate in flexibility and speed of deployment. With proper planning and logistics, modular data center units can be built ahead of time or while the remainder of the project is under construction providing just-in-time deployment. This is a particularly efficient use of time. The modular data center is fabricated in the assembly plant and, if necessary, stored until ready to be deployed. This concurrent construction occurs while site permitting is being processed and site work and support construction is happening. The modular Data Center, which is built offsite in a controlled setting, is shipped to the project site when needed. Modular, factory-built, repetitive units provide a higher level of quality due to the indoor controlled construction environment and the ability to make continuous process and performance improvements.

Not all modular Data Center designs are the same. Designs can be based on providing a complete modular Data Center including infrastructure and IT equipment room space and are shipped to the site fully assembled; or based on providing components in a modular form that are shipped to the site for assembly. Alternately, portions of the Data Center can be assembled offsite including electrical equipment and cooling systems and then installed in existing or newly built spaces speeding deployment and limiting on-site construction time. Modules can consist of skid mounted equipment, complete enclosures in one package, ISO shipping containers or a series of modules that assemble at the site to create a complete Data Center.

Some treat the module as a piece of computer equipment; variations on this theme include individual cabinets or entire modules or containers that are pre-loaded with servers. IT equipment is purchased in bulk and when they arrive on site, are plugged into the site utility systems one cabinet or one container at a time. Another iteration of this theme are modular data centers in ISO type containers that are pre-loaded with multiple cabinets with IT equipment already installed. The module is then plugged into site utility infrastructure. Modules can be designed to be located indoors or outdoors. These approaches can improve the speed of deployment and with planning, can result in just-in-time additions to the IT system.

However, these methods can often require proprietary IT equipment. While the speed of deployment is attractive, Data Center owners need a system that is more flexible.

Integrated Design Group has designed modular data centers and components for clients including a large Data Center wholesaler, Colo providers and several major financial corporations. These projects have challenged us to achieve flexibility and other desirable features, which include:

1. Entire Data Center is assembled at the site from pre-fabricated modules. Equipment is pre-installed and wired. Only connection to the utilities and module cross connection wiring and piping is required at the project site. Cabinets can be pre-installed with or without IT equipment.
2. Third party inspection and Underwriters Laboratories Inc. (UL) testing. Unit should meet the requirements of the proposed UL Subject 2755 Outline of Investigation for Modular Data Centers and the proposed NEC 2014 National Electrical Code Article 646, Modular Data Centers.
3. Flexible computer room size. The size of the computer room can be right sized to meet the Data Center owner's needs by adding additional modules. The computer room should support cabinets, racks, storage units and mainframe-type computer equipment. We recommend that the interior should be open and clear with minimal columns to interrupt the layout of equipment. Clear height should be eleven feet or more to provide adequate space for overhead power distribution and cable trays. Raised floor can provided for air distribution, cable distribution and flexibility of IT equipment layout. As Integrated Design Group has found, with proper design planning, additional

modules can be added to existing operating units with minimal risk to the operating computer space.

4. Architectural considerations in regards to efficient flexible layouts, water tightness, aesthetic considerations of the site and the owner's desires, building code egress requirements and compliance. Early discussion with the local Authority Having Jurisdiction (AHJ) is beneficial and may reveal a requirement for inspections at the assembly factory by a third party approved by the AHJ in addition to any UL or ETL inspection label. Integrated Design Group believes the greatest risk lies in poor assembly, which could lead to air and water leaks. The more joints introduced into the modular Data Center, the greater the chance of leaks being created, and the less efficient the unit assembly becomes.
5. Energy efficient and flexible power distribution that allow various kW equipment loads, types of load connections, ampacities and voltages. 480/277V, 400/230V or 208/120V power to the IT equipment should be available. Systems should be designed to provide N+1 or 2N equipment and 2N power distribution to provide concurrent maintainability and fault tolerance if required. UPS systems, batteries and power distribution equipment shall be installed in the modules and shipped to the site pre-assembled and wired with minimal wiring required on site.
6. Cooling systems that provide concurrent maintainability and fault tolerance if required. Systems shall meet the latest energy codes such as ASHRAE 90.1-2010 or IECC-2012. The system should be flexible to cool the range of equipment that could be installed. Hot/cold aisle containment should be used to improve the energy efficient performance of the cooling system. Design should allow for addition of a refrigerant or water-cooling system to permit rear door heat exchangers, water-cooled mainframe equipment or direct-to-the-chip type cooling systems. These systems allow high temperature, low energy use cooling systems with the minimization or elimination of chiller or compressor type cooling systems. The base system should have economizer systems to minimize electrical use by the cooling systems during compatible weather conditions. Choice of air, water or pumped refrigerant economizers will lower the total energy used and the data center PUE.
7. PUE calculation as defined by the DOE and the Green Grid. If PUE does not include the total energy required to operate the Data Center from the utility to the IT equipment, then it should be clearly stated. Declaring a low PUE that only includes a small portion of the total energy used is common and can be avoided by asking for complete documentation of how PUE is calculated and what it does not include.

Integrated Design Group's experience in modular data center design has given us the opportunity to identify and remediate specific challenges with this type of project. When considering the construction of a modular data center, the design is limited to building modules within the size constraints permitted for shipping. Shipping and assembly costs can be substantial and the design should be considerate of the potential tradeoffs. For example, if a design requires a fourteen-foot ceiling but the shipping size is limited to thirteen feet, an owner may consider other types of equipment or layout to be used in the data center. If that equipment or design layout is desired, multiple units may be stacked to create a larger interior space. Innovative use of the space and how it is assembled is critical to achieving the proper dimensions and layout to promote efficient use and operation of the Data Center.

Since the container is built off-site, it will ultimately have to be shipped to the site. This creates challenges because the modular Data Center must economically fit the constraints of its transportation method and route to the site. It is important to know the size limitations of the modular Data Center for shipping before construction begins so there are no unforeseen problems later on. Considerations include height and width of the module. Above certain sizes the shipping costs increase due to the need to find

compatible routes, the need for escorts, etc. Weight is also a concern because of the type of vehicle that may be used for transportation, the available routes and the crane required to install the modules.

Based on our experience designing modular Data Centers, we urge facility executives to ask these questions about their own facilities and organizational needs when considering a modular Data Center:

1. *Are there any spatial constraints on the site?* A modular data center can take up very little space; modules are typically about the size of a tractor-trailer unit. They can be stacked and placed next to each other as needed, as opposed to building an entire Data Center if it is not immediately required.
2. *How quickly does the Data Center need to be built?* Speed of deployment is a major advantage of modular Data Center design. Less on-site construction is involved with modular Data Centers; construction time may be as short as a few months, including commissioning versus a year with a full Data Center construction project.
3. *Is on-site security an issue during construction?* The construction of a modular Data Center cuts back on security risks because the assembly, which happens on site, requires very few people. For confidential projects, this greatly reduces security risk, as the number of people on site is much smaller.
4. *How Flexible is the modular Data Center design?* How easily can our equipment and operational requirements be implemented? Is different IT equipment required? Do operational procedures need to be changed? How does this integrate with the existing architecture and site?

Modular Data Centers can be the appropriate solution for many types of projects but do come with their own set of pros and cons. One size does not fit all. There are many varieties being developed to meet specific requirements be it speed, cost, flexibility, security, etc. The key is to define your project goals and requirements and to work with experienced design professionals to select the optimum solution for your project.