AABC Commissioning Group
AIA Provider Number 50111116

Speed to Market: How to Commission a Modular Data Center in Today's Marketplace

Course Number: CXENERGY1711

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April 26, 2017

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Course Description

DOE estimates data centers consume two percent of all electricity produced in the U.S. A significant trend in the marketplace is the use of modular data centers, a portable method of deploying capacity that can be placed anywhere data capacity is needed. This presentation covers the evolution of the data center marketplace and the challenges of purchase/design/build as it relates to modular data center commissioning.

Learning Objectives

At the end of the this course, participants will be able to:

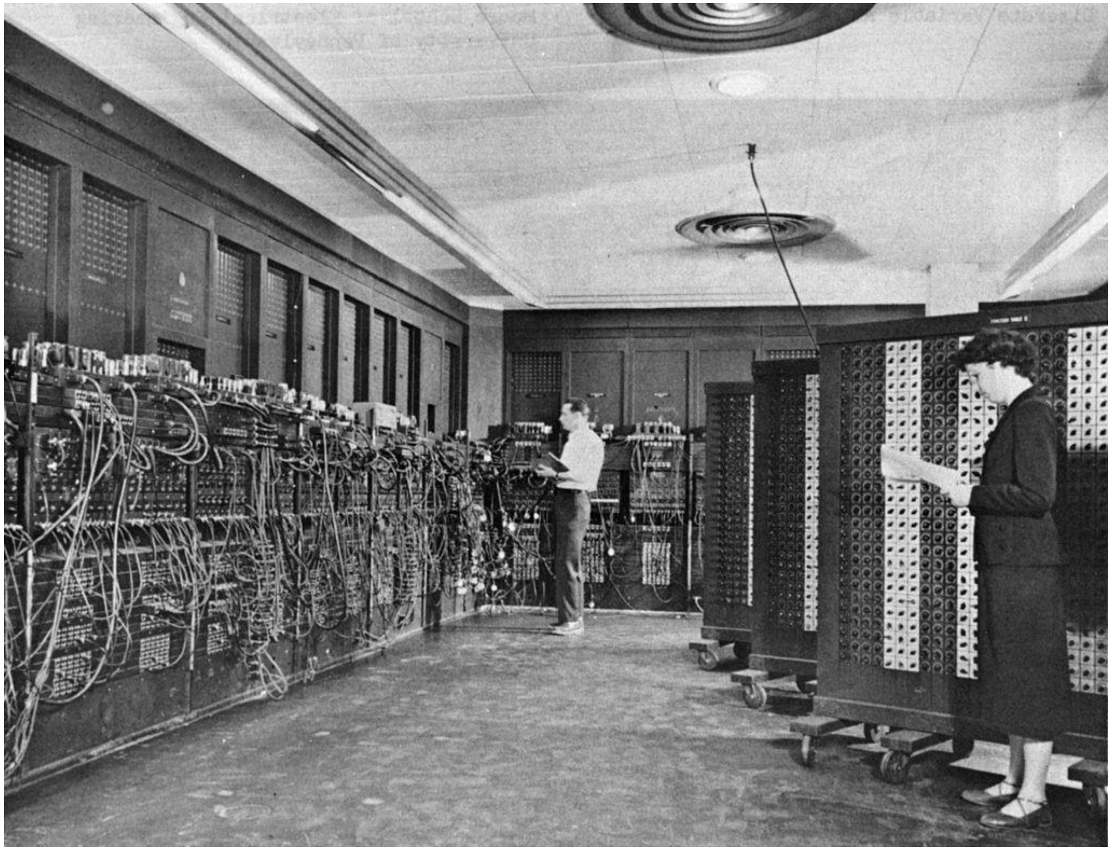
1. To understand the evolution of the data center marketplace.

2. To understand the differences in delivery of a modular data center when compared to a “brick and mortar facility.”

3. To understand the challenges of purchase/design/build as it relates to commissioning.

4. To understand the “lessons learned” of commissioning a completely modular data center.

Data Center Evolution

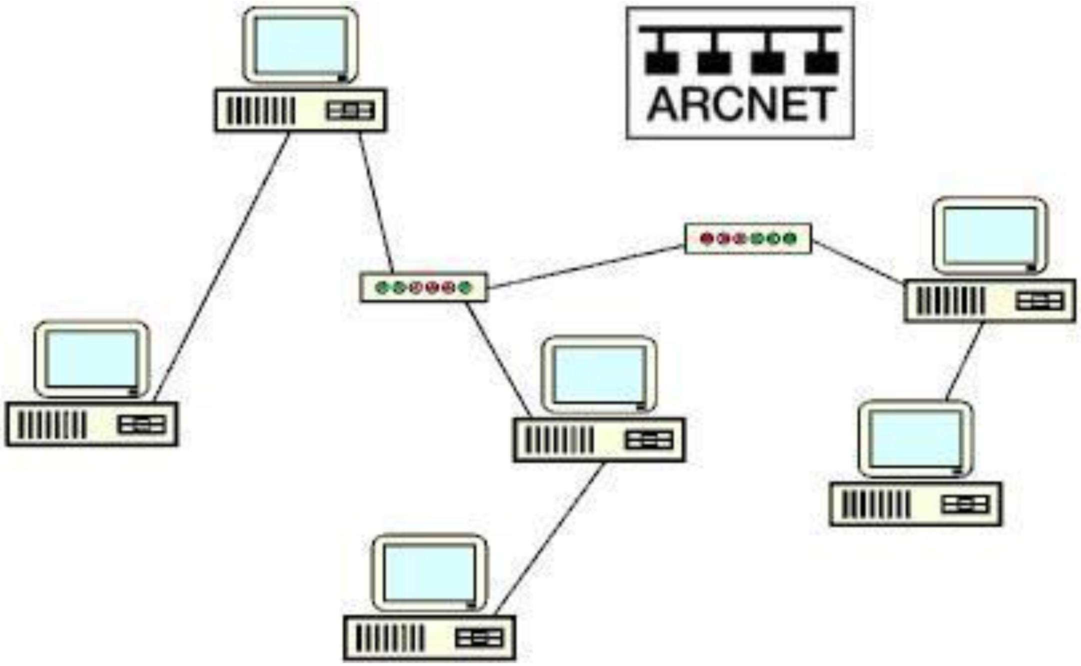


Electronic Numerical Integrator And Computer, ENIAC was built in 1946 for the U.S. Army Ballistic Research Laboratory to store artillery firing codes.
1,800 square feet of space delivered 150kW if computing load

Data Center Evolution

CDC6600 was delivered to CERN in 1965. Processor speed of 40Mhz

Data Center Evolution

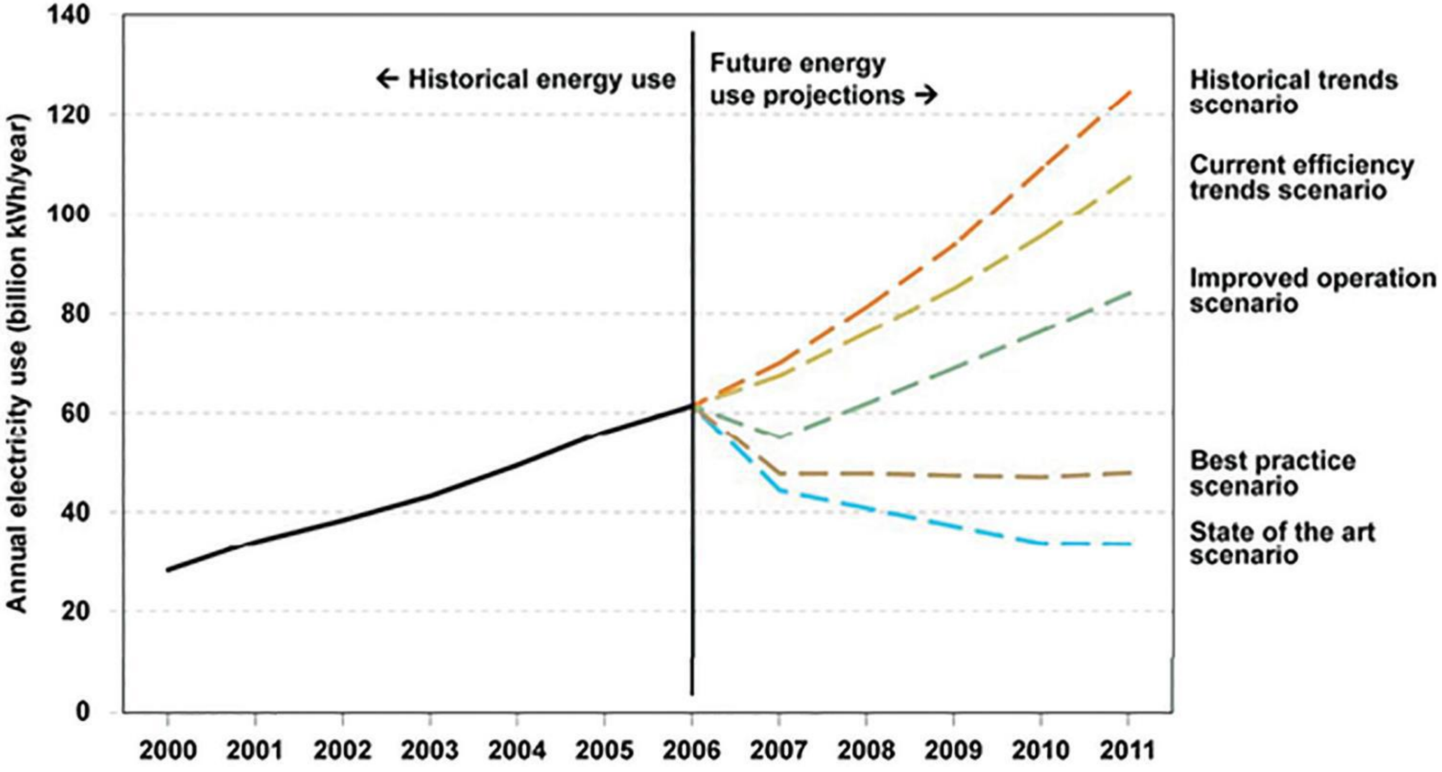


1971 saw the first commercially available LAN network system installed by Datapoint using ARCnet for the Chase Manhattan Bank in New York. The system used coax cables and shared floppy drives.

Data Center Evolution

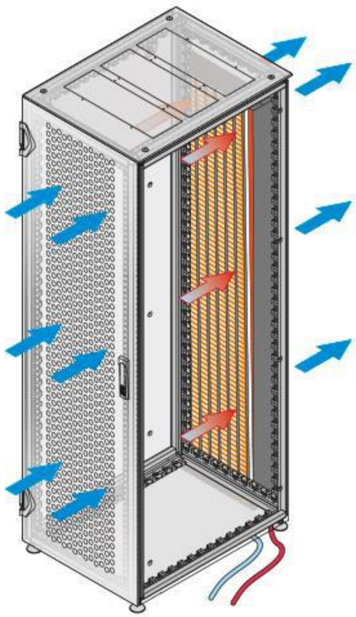
1980’s saw the rise of the personal computer which actually slowed the growth of networking computers together.

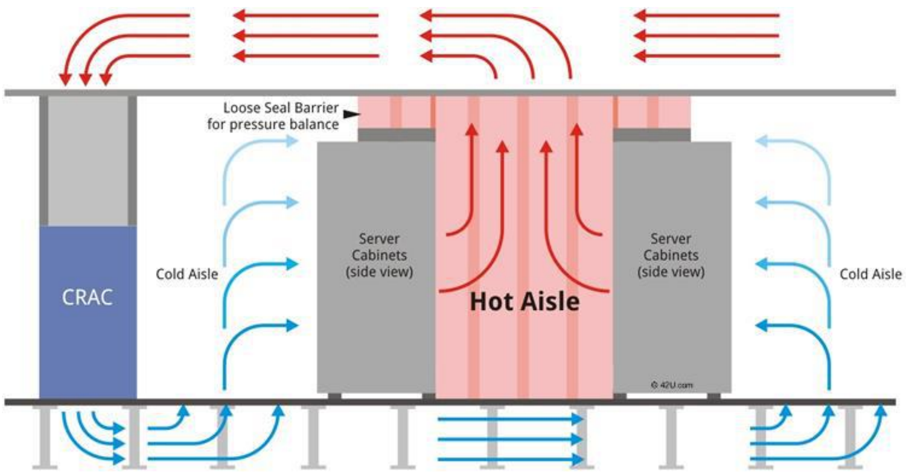
Data Center Evolution



By the 2000's the energy consumption of data centers equal 1.5% of the total power consumption of the United States and it was growing by 10% a year.
5 million new servers a year were being deployed to keep up with the demands.

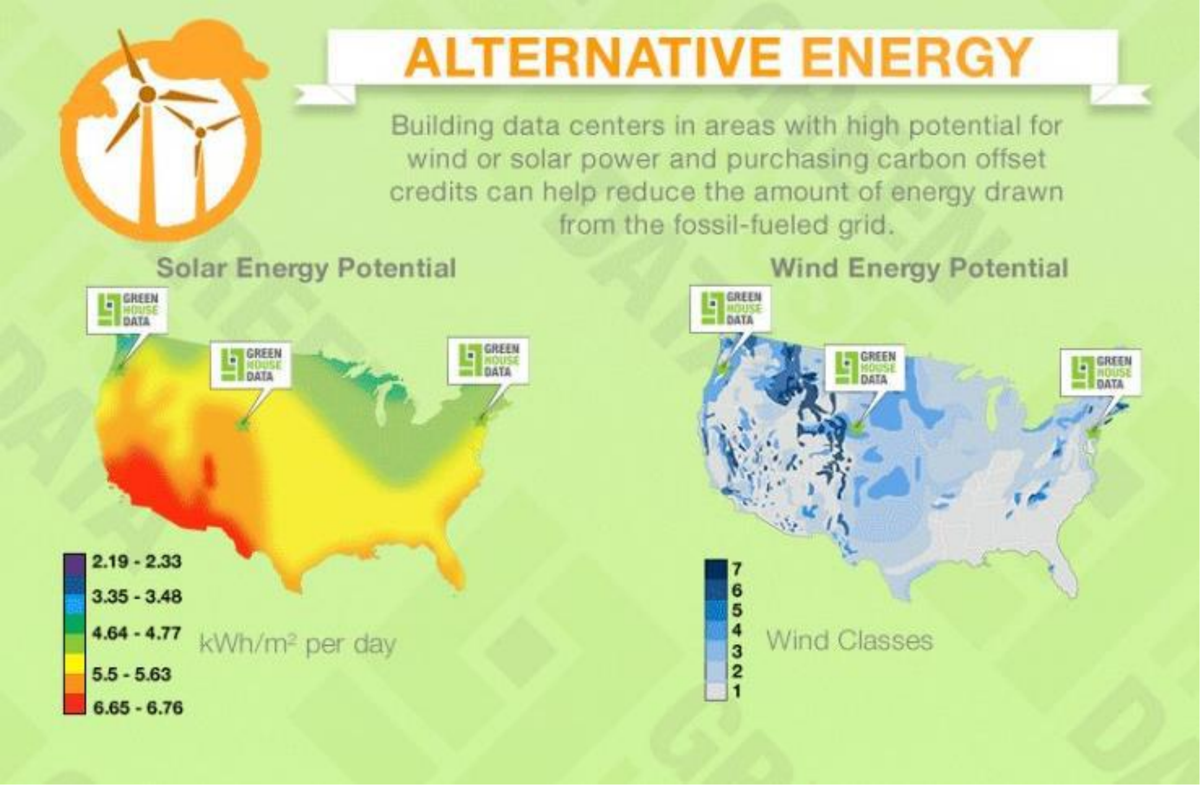
Data Center Evolution





Manufacturers, such as Dell and IBM, began to focus on energy efficient components to combat the energy consumption concerns.

Data Center Evolution



By the mid-2000's, large data center operators began to leverage renewable energy resources, such as wind power, as a means to reduce energy costs.

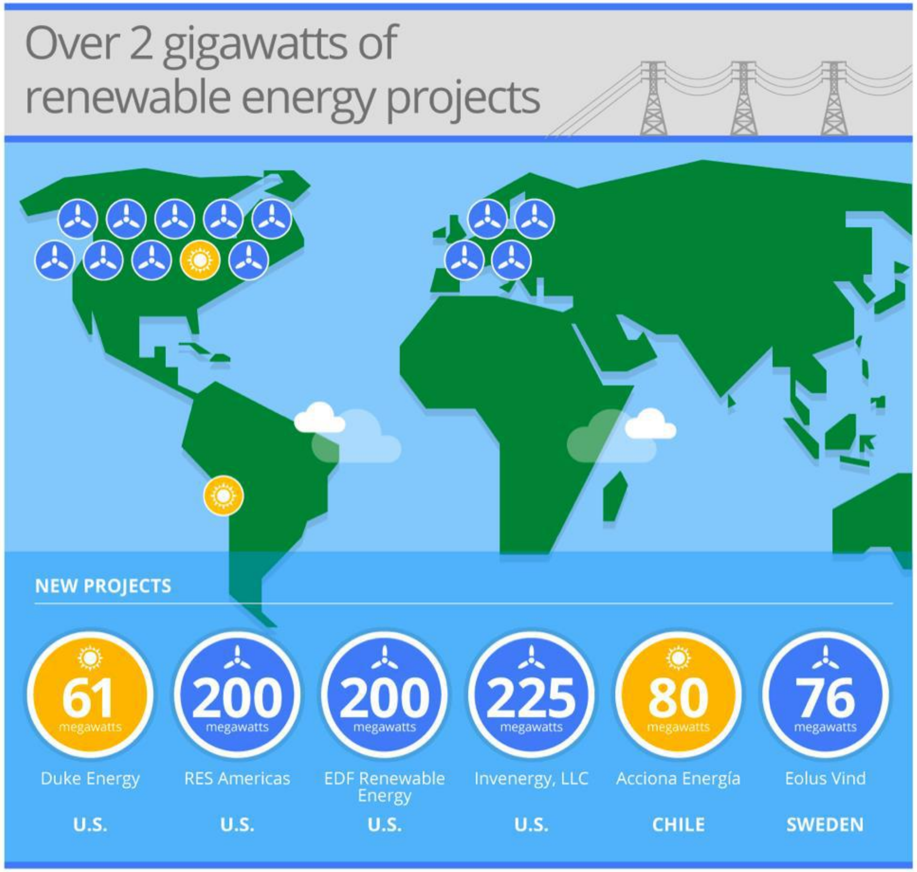
Data Center Evolution

By the mid-2000's, Sun Microsystems developed the "Black Box". It housed 280 servers in a 20ft long shipping container.
Google had been working on a patent since 2005.
The modular data center is born.

Data Center Evolution

Current day, the demands of the “cloud” have outgrown localized, dense computing needs. Now the demands of video, music, 24 hour news, social media outlets, phone, and general internet require large farms. So containerized modular data centers are the focus of these sites.

Data Center Evolution

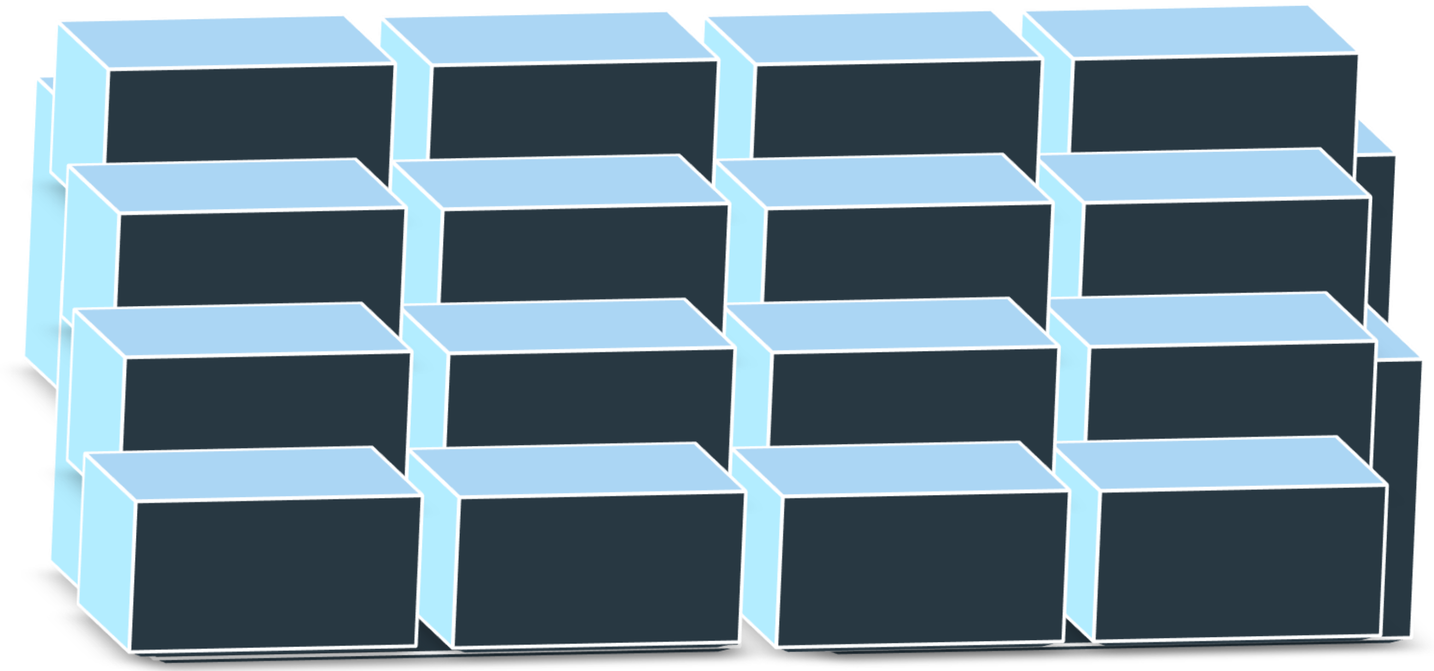


Governments and utilities began to court companies for bringing data centers to their areas with huge rebates and promises of green power.

Data Center Evolution

Modular data center is not an industry standard
Modules can be power modules to support a Data Center
The module itself can be the Data Center
The module can be stand alone or tie into an infrastructure
Can be expandable in quantities of capacity on a site based on energy availability

Data Center Evolution



Meant to be thought of as duplicative, exact down to the bolt
The module itself is an "off the shelf" product
Modules of constant size, built together for increased capacity requirements
Single source vendor with the goal being cost reduction through constant repetition – high volume, low cost, fast turn around

Data Center Evolution

Shipped all over the world from key distribution hubs or factories
Instant deployment from multiple locations from around the world
Key suppliers, such as, Vertiv (formerly Emerson), MTU, Schneider Electric

Data Center Evolution

Multiple sites of modules bring total capacity up as demand requires
This is the cloud.

Modular Data Center

How do modular data centers compare to traditional data centers?

- Size – foot print, capacity
- Impact to existing infrastructure is reduced

What are some of the design, construction, and operational benefits?

- Template designs
- Template submittals
- Known lead times
- Known time to market

What are some of the design, construction, and operational challenges?

- Colo space vs single tenant
- Evolution of products
- Applying “lean” ideals
- Site specific requirements, government regulations
- Local codes

Commissioning a Modular Data Center

"Standard" scope of work still pertain:

- Design reviews
- Submittals reviews
- Installation checklists
- Test procedures
- Site visits

Execution, timing are performed differently

- Level 1
  - Design Review could be more traditional but with blocks
- Level 2
  - Submittal reviews
  - Factory Acceptance Tests (FATs)
- Level 3
  - Site Acceptance Tests (SATs)
- Level 4
  - Functional Performance Testing
- Level 5
  - Integrated System Testing

Commissioning a Modular Data Center

Level 1

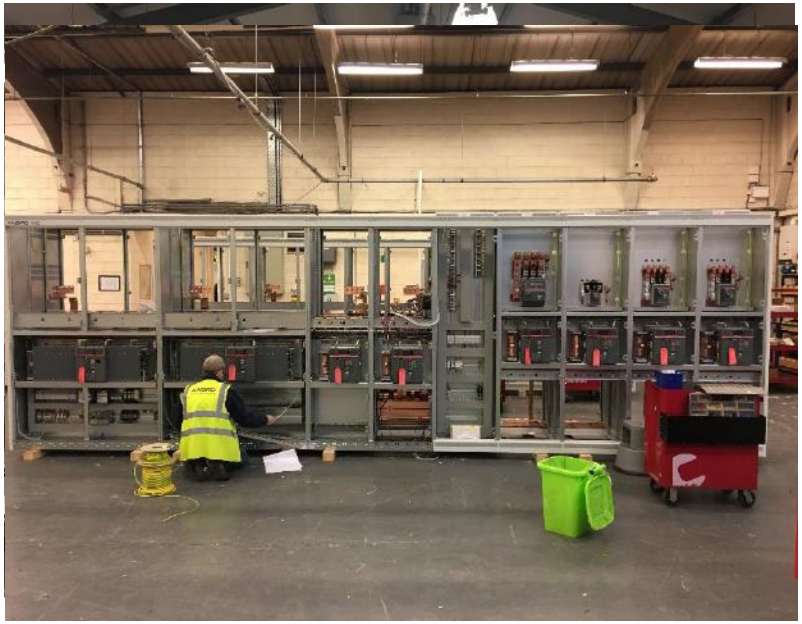
- Design Review
    - Focused on capacity, reliability requirements
    - Begin to identify load bank plan, commissioning plan NOT the Commissioning Plan
        - This refers to the execution, scheduling of events
- Get a feel for “module” design, construction schedule
- Develop Commissioning Plan
- Leave Level 1 with DRAFT tests for CM/GC/EOR review

Commissioning a Modular Data Center

Level 2

FATs - Equipment, component testing

- Breakers
- Meters
- TVSS
- Switchgear
- CRAC
- Generators
- FA, FP



FATs - Integrator of the Module

Power Module

- UPS (without batteries) with CRACs, Maintenance Bypass Cabinet and Main Board
- Integration with Auto Transfer Controller to Generator Input

FATs - Data Center Module

- Power module plus simulated heat load operation

Site Photos

Site Photos

Commissioning a Modular Data Center

Level 3

SATs

- NEN1010, BS, NETA, IEEE site testing
  - Conductor from power module to building/infrastructure and to data center
- Final vendor startups
  - UPS with batteries
  - Main switchgear with generator and utility
  - Integration to building/campus FA
  - Integration of all equipment to building/campus BM/AS
  - Generator, UPS site load bank
  - Remote Power Panels, Static Transfer Switch startups

Commissioning a Modular Data Center

Level 3

Non-Cx'ed equipment interaction

- Client, end user security
- Hot aisle/cold aisle containment
- IT cabinets, racks
- Site grounding, lightning protection

Defining scope….

How much involvement in Level 3?

- Huge value, time to only see some testing
- Huge cost to spend months at the factory, integrator?

- Alternately, gather and review ALL Level 3 documents

Commissioning a Modular Data Center

Planning for Level 4

- Web based application, immediate response to Cx Issues
- Require a Commissioning Liaison from CM/GC
- Define load bank plan as a script for movements of load banks
- Who is providing load banks, transient recorders?
- Detailed Cx Schedule by equipment
  - Plan for multiple shifts
  - Coordinate EC, MC, CC, vendor support

Commissioning a Modular Data Center

Level 4

- Test non-interactive equipment as multiple shifts
  - Generators, CRACs
  - FA, FP, Breakers operations
- Test every point, operation through every sequence
- Perform only after BM/AS is operational and visible
- IR Scanning points
  - Who needs to support and remove covers, provide PPE, and camera?
- Script each day's activities with manpower needs
- Host daily Commissioning meetings for hourly planning sessions
  - Discuss constraints, opportunities
- Status percent complete of each test for targeting towards Level 5

Commissioning a Modular Data Center

Level 4

- Outside of the module, traditional data center approach
  - Account for failures, plan for retests, witnessing Cx Issues closed out

- Long days, long nights

Level 5

- Pre-test as a simulation
- Execute over 2-3 days
- Trending, staging of resources for witnessing, documenting
- Clean-up and go home

Level 6

- Final Report, Executive Summary (> 7 days)

Challenges / Lessons Learned

- Have a strong grasp of schedule for each Level
- Have a large, fast reacting team
- Understand the client delivery schedule and how it integrates commissioning
- Does your scope include Level 3 or just Level 4/5?
- Do you have any Level 1/2 scope of work?

Questions & Answers

This concludes The American Institute of Architects Continuing Education Systems Course