



UNRAVELLING DATA CENTRE POWER IN AN OFCI WORLD

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Introduction

In this white paper we look at some of the key considerations when providing critical power systems to hyperscale data centres in an Owner Furnished Contractor Installed (OFCI) procurement environment. We look at;

- Today's Data Centre environment
- Traditional procurement methods
- The pro's and cons of OFCI
- Supply chain challenges
- How the move to modularisation can help

Today's Data Centre Environment

Today Data Centres are at the forefront of demand in the construction sector, with investment continuing apace and expected to remain so for some significant time into the future. This growing demand is lead largely by the;

- Rapid development in AI
- Data-intensive machine learning
- The work from home culture
- Increasing requirement for cloud services
- Distribution of video-based content distribution and streaming services



In this environment of rapid growth, speed of delivery of infrastructure is key if the Data Centre owner wants to be successful. It is a race with contracts to take space for the provision of data services being awarded to the developer who can deliver infrastructure at the fastest possible rate. We know that both

during and in the months after COVID, the sourcing of both materials and skilled labour was tough and, in many cases, remains so today, with construction timelines principally built up around things such as

- Planning and permitting requirements.
- Finalising design.
- The availability of labour.
- Managing the logistics of critical IT, electrical and HVAC equipment.
- Reducing or removing some of the critical construction of supply chain pinch points is critical.

To meet the demand and speed of delivery, providers of data services space need to expand beyond traditional delivery models and explore solutions that both fit their construction and operational needs.

What is Contractor Furnished, Contractor Installed?

The traditional construction procurement model which has been used for decades to build infrastructure projects both large and small including data centres is what we now call CFCI - Contractor Furnished, Contractor Installed. It is a model that is still in wide scale use today including to build data centres of all sizes. This procurement model is where the owner / developer contracts individually with the design team, consultants and construction company in a linear process as the planning, design and construction phases of the project develop. The method brings with it many advantages such as

- Everyone involved clearly understands the project.
- The design and construction teams remain separate, bringing with them the appropriate checks and balances needed to help protect quality control and design intent as set out by the owner / client.
- The owner or client holds the reins of the project, maintaining control over all aspects of the design and how it is implemented.
- Financially, this method encourages competition, generally providing the cheapest option to the client.

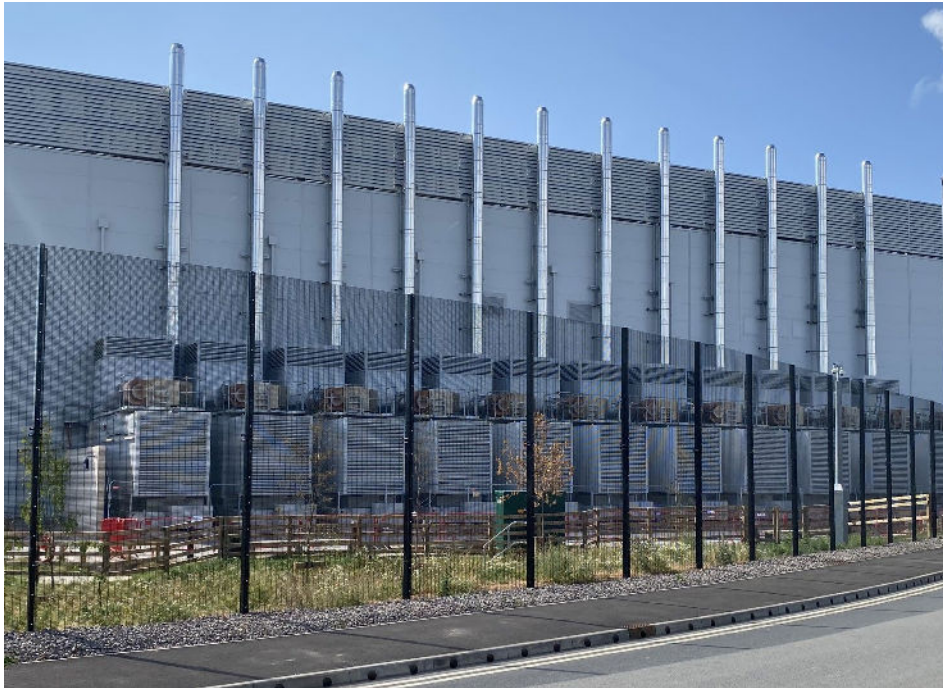
The CFCI model also comes with its disadvantages, including things such as

- The owner must have the expertise and resources in house to manage the project team, help resolve design and construction issues, and take responsibility for design errors and changes.
- There is limited opportunity for value engineering and collaboration across the project to try and achieve any programme enhancements as these are usually made by overlapping design and construction activities. These factors can and do affect final project costs.
- The owner / client is very reliant upon the contractor that they select having the technical expertise to support their selection process.
- The client generally ends up with the cheapest option rather than the best value.
- The client very rarely gets the option to consider or optimise “lifecycle costs” and operational costs.
- The owner or client rarely has a say in the selection of key equipment. This denies them the opportunity to achieve product commonality across sites, secure volume discounts and introduces the need for them to deal with multiple vendors for ongoing through life product maintenance etc.

There are of course also a number of hybrid versions where, for example, client tenders to ensure best price then up grades supply to his preferred choice taking the extra cost hit.

What is the alternative – OFCI? – Owner Furnished, Contractor Installed

Is there an alternative to the CFCI procurement model? The answer is of course yes. As we considered earlier, there are hybrid versions of CFCI and whilst very different the OFCI alternative can fit well into many project environments none more so than hyperscale data centres, however it brings with it some challenges.



So, what is the Owner furnished contractor installed model - OFCI? This method of procurement is where the developer/ owner / the end client directly procures (purchases) the high-cost capital equipment or long lead time plant with the intention of then issuing it to the contractor for installation. The owner / developer then tenders the construction contract in the usual way with the successful contractor and fit out partners between them taking on full design responsibility and all project completion liabilities.

This is the period of maximum risk for the project as

- The owner / developer has either already placed orders for key equipment or in a rush to place orders for other long lead time equipment.
- The contractor and team(s) are still getting to grips with the project itself, seeking to understand what the owner has ordered or wants to order, whilst urgently trying to develop and complete a final design so that everyone can understand if things will fit and if everything will work when it comes to site. Alongside this, the contractor must also order equipment not included in the OFCI plan.

If this period is not managed well then significant time can be lost as well as money, therefore the owner/developer's decision to directly procure equipment should be led by the overarching procurement strategy of his organisation. It is important though that where the OFCI strategy does not meet project or organisational requirements, it can also add significant risk to the project.

Here then are some of the advantages that the client / owner / developer of using this model are

- They have direct access to the supply chain, facilitating a level of standardisation of products across his estate.
- Permits them to build strong relationships with supply chain providing "in project" involvement in the design and access to view the manufacture and testing processes.
- It allows increased client buying power, for long term procurement planning, for the pre-ordering of equipment and hence shortening lead times.
- It provides the opportunity for improving value within a project.
- The opportunity to spread project cash flow over a longer period.
- Ease in securing agreements for on going through life maintenance and access to spare parts.
- Can also improve quality by utilising modular offsite manufacturing and repeatable design.

There are of course disadvantages to the use of this model and this includes things such as

- Introducing additional risks into the project by the blurring of the lines of the contractor's responsibilities, exposing the potential to undermine the design responsibility of the contractor as they have not been responsible for the selection of key equipment. If the client then attempts to reallocate this risk using more stringent contractual terms, it risks the possibility that contractor(s) inflate their costs to account for this increased risk.
- A failure to capture full design scope or local regulatory requirements which can make integration into a local setting more complex with the potential for changes required to the client "standard" product. This can delay final design or even add costs if discovered later into the project programme.
- Limits the supply of key equipment to one or two manufacturers.
- Can erode value in the project.

OFCI – Supply Chain Challenges

With many of the major hyperscale builders / owners based in the US; the use of an OFCI procurement strategy can bring with it a number of challenges for the supply chain especially when this strategy deployed on their estate outside of the US. For example;

- Establishing the final design can be exceedingly difficult if the potential project locations fall under multiple regions, countries or even continents each with different regulatory, legislative or climatic conditions.
- Some of the specifications generated in US don't readily fit into other markets...different standards i.e. site permitting, planning, switchgear, generator emissions, local noise level requirements etc.
- Sometimes the specified / approved products aren't always available in all markets due to variations in products which are made to accommodate variations in local standards. Again this can delay project design sign off.
- OFCI procurement is often driven using a "perceived standard product(s)" concept which in practice doesn't always work due to site variations, legal jurisdictions, etc leading to cost inefficiencies.
- OFCI procurement should always be supported with an overall scheme design to ensure that all equipment requirements are captured – this can take time and delay the project. In reality, the projects may need to be done on a case-by-case basis so that each project will stand alone as a bespoke project, with different designers and contractors. In such cases the interface between OFCI procurement and Construction procurement can become disjointed which in turn will increase project risk.
- Using a responsibility matrix during the OFCI procurement process can help to mitigate this risk and will convey responsibility to stakeholders.

How Can Modularisation Help?

Today we see modularisation being used widely across the UK and Europe and in a number of different sectors for example in house building, healthcare and in the delivery of some sizable M&E infrastructure projects. These ideas are also now being used in hyperscale data centre builds too; mostly in order to speed up the construction process. So how can and does modularisation help? Modularisation of parts of a Data Centre build can bring a time and cost advantage which can be attributed to several factors, including:

- Flexibility
 - Flexibility to be upscaled as and when site requirements grow or change.
- Simplicity
 - Keep it simple, the more straightforward the process is, the more likely the project is to stay on programme and within budget.
 - Built in a factory-controlled environment and then transferred to site as a fully integrated power solution, does significantly reduce cost and integration risk at site.
 - Site working hours significantly reduced.

- Space
 - Building 'Brick & mortar' facilities for example the critical power train can be extremely costly.
 - Modular Power and HVAC equipment can be located in a convenient space outside of the building envelope leaving more internal space for IT kit.
 - OFCI equipment is often available ahead of construction phase requirements which provides an opportunity for early integration and delivery of the equipment to site.
- Energy
 - Pre-fabricated modules are operationally much more energy efficient than traditional equivalents as the power and cooling system controls are pre-engineered to be better integrated and hence operate more efficiently.
 - Modular equipment is less likely to be affected by any on-site construction issues.
 - During the installation phase, on-site man hours can be reduced by as much as 80% with over 70% fewer lifting operations required when compared to a traditional installation.
- Safety
 - Safety is easier to manage in a factory environment with few working hours on site significantly decreasing the risk of accident or injury.
 - Rigorous Factory Acceptance Testing (FAT) can be undertaken in a controlled environment before being shipped to site.
 - Equipment is tested under factory-controlled conditions, potential to achieve level 3 testing of all equipment before it is shipped to site.
- Quality
 - Reduced risk of any aesthetic damage being done to equipment that may have occurred from other trades during an on-site installation.
 - Each power module arrives on site fully prewired, commissioned and ready to connect up...true plug and play.
- Commissioning
 - All elements thoroughly tested prior to delivery and this includes BMS/PMS interfaces which are pre-wired to a hub within the power module simplifying connection at site.



Advantages of Modularisation

The idea of modular construction can extend the concept of supply chain pre-positioning beyond just the critical electrical and HVAC equipment into other areas of the building itself. A building can be defined as a number of functional subsets (the essence of making it modular). This allows Data Centre owners to take scope out of onsite construction and move it to offsite fabrication both broadening and extending the scope of the OFCI packages. The OFCI packages can be designed ahead of time or designed as an owner standard, all of which works to reduce the risk particularly in the period after the construction contract is awarded and the project design finalised.

Pre-fabricating a standard modular structure and integrating it with standard critical IT, electrical or mechanical equipment in a manufacturing setting allows those modules to be pre-positioned for deployment to any region in a Data Centre owner's portfolio in a fraction of the time. This approach also

- Reduces on-site labour which is at a premium.
- Reduces capacity delivery time issues whilst ensuring more predictable product quality.

One key benefit is having the opportunity to undertake extensive offsite testing of the modular systems for example the entire power train to level 3 status prior to shipment. In the first case of its kind this could be to level 4 status. This can save a significant amount of time. Modular construction can also;

- Significantly reduce site installation time, site commissioning and testing time and removes some of the product integration risks which are only discovered at site.
- Open up the opportunity for organisations to provide a one stop shop modular solution which includes design, fabrication, fit out, test, installation and commissioning.
- Reduce cost and time in design phase as all done with one supplier.
- Vendor neutrality of packager.
- Cost savings for example on transport and reduced number of site lifting activities.
- More efficient use of skilled labour, more productive time each day focused on the task and less time spent travelling to and from site.
- Systems e.g. cooling are easier to integrate and made more energy efficient as a result of optimising the design.
- Modular solutions can be scalable allowing the client to build space when needed.

Modularisation of the Power Train

As a supplier of critical power systems, I guess you would expect me to look at how modularisation can bring advantages to clients in the OFCI environment. It is possible to fit all elements of the critical power train across two or three containers depending on rating configuration and scope of requirement. This offers a significant reduction in the space needed to deploy the equipment as a number of different module configurations are possible, for example on a two or three deck gantry configuration.

- The modular critical power train can include all or any of the following
 - 11kV/400V Tx and RMU
 - LV switchgear including generator changeover panel
 - UPS and Battery system also including room cooling
 - Generator, fuel storage system, Flue system including SCR
 - Busbar and cabling
 - POD Cooling
 - Fire detection and suppression
 - Lighting and small power
 - Gantry and access systems
 - Installation
 - Cable or busbar solutions
 - Full Factory Testing, Commissioning and Site Testing
 - Full all product service and maintenance support

Using this approach means that the entire power train is available as a "Plug and Play solution".



Advantages of a one stop shop modular design

What could a one stop shop solution include? The design, fabrication, fit out, FAT, gantry system, site installation, off load positioning, external busbar and cable, commissioning and SAT. It can also include partial or full procurement by the vendor depending on client preference, which again comes back to the procurement model the client is using. Additionally;

- Modular units are designed to match the external requirements of the build space.
- The package can be configured in a way best suited to the site, optimising the available space. Equipment can be located on the ground or on a gantry, modules or PODs can be configured side by side end on end or a combination of both.
- External plant permits maximum internal white/IT space the internal space saving can be significant.
- Power train specification and design can often be concluded more quickly than rest of DC fabric and infrastructure reducing lead time.
- Often OFCI equipment is available ahead of space being available on site.
- Early availability of key equipment permits early modular integration, testing and delivery to site.
- Stage 3 testing and integration of power train can be conducted away from site ahead of delivery.
- Avoids potential accidental damage to equipment when being installed in a pressured “on site” working environment.
- Early delivery to site can advance site programme by
 - Allowing earlier installation of cables to all areas of site.
 - Allow early power up of critical equipment to facilitate commission and testing, again advancing programme.

Knowledge, Experience and Expertise

We all know that knowledge, experience and expertise play an important role in ensuring that projects of the type we are talking about here all come together. Sometimes it is just those little things, an informed input here, a small tweak there at the design can make all the difference. This is so important in the OFCI environment when the client is very reliant on the design team to ensure it is right and it works. We conclude this paper with just a couple of examples where an experience design team can help optimise the design and save cost.

- When bringing together and integrating into a package, a number of products from suppliers selected by a client can come with challenges. The kit can be too big, dissipate too much heat for the given accompanying cooling plant, or it doesn't meet some of the criteria imposed by the planning or permitting consents etc.
- We had recent experience where a client selected a vendor to supply a switchboard into an E-POD package. The switchboard configuration didn't readily lend itself to the use of busbar which they had also requested to be used on the project for all the main power connections. This anomaly was picked up very early in the design stage and flagged to the client. The close working relationship with the client and the resultant direct route to the client and his team was quickly resolved well ahead of any steel being cut.
- As we know there are variations in product packaging sizes between manufacturers; for example, rated UPS do vary in length and depth. These variations can open opportunities for optimising overall module footprints. The same is true with the UPS batteries. The most cost-effective solutions don't always provide optimal use of space and can add cost to the project.

These are just a couple of small examples of where that knowledge and experience can pay dividends for the client.

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Geoff Halliday started his career as an apprentice working for Square D (later part of Schneider) before moving into the critical power sector where he has now worked for over 40 years, splitting that time equally between both the UPS and standby diesel generation sectors.

During this period Geoff has held several roles ranging from Customer Service Engineer, Project Manager, Technical Director, Sales Director through to Managing Director.

The Critical Power market exposes the individual to a wide and diverse range of market sectors ranging Health Care, Life Science, Water Treatment, Banking and Finance, Military, Manufacturing, Process Control through to Data Centres of all sizes. Drawing on his management skills, product knowledge and vast application experience amassed throughout his career Geoff now enjoys sharing his knowledge with others.