KIPO
POWER CONSULTANTS

CONTAINERISED DATA CENTRES DESIGNS

Summary of Specialist Services and Relevant Case Studies

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ABOUT KIPO

We are not your average MEP consultants, as we are specialists in the following services:

- Specialist Selectivity and Protection Studies
- Specialist Arc Flash and Short Circuit Studies
- Scada/Generator Controls Optimization or Replacements
- Transient Studies
- High Voltage and Heavy Low Voltage Design
- Earthing Studies and Design
- Electrical Services Distribution Design
- Engineering problem solving on site level including defects checks and survey work
- Review of the completeness of the O&M manuals
- Photographs and the assessed status of the MEP services, including obsolescence, remaining estimated life expectancy, defects, concerns, repairs needed, safety concerns and visual condition
- Any recommendations as to further validations, testing and performance certifications
- A narrative table, describing the condition of the services, proposed action required, risks, risk mitigation, estimated duration of the project, client/customer disruptions and budget estimates
- Report with an executive summary, introduction, method and approach, photographs, to change equipment/plant conclusions and recommendations

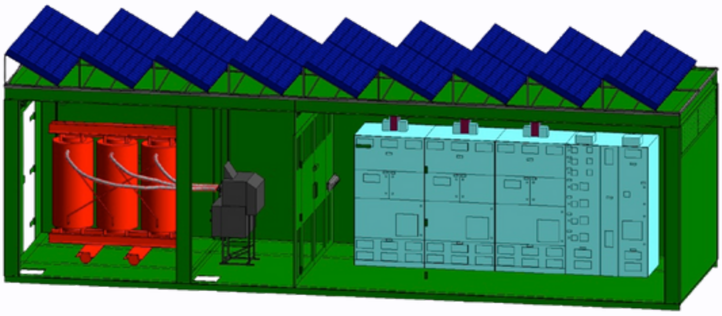
CONTAINERISED SOLUTIONS

Our containerised solutions are specifically designed to house plant and equipment for Data Centres.
For reasons of modularity containers are used for two purposes:

1. To standardise a container and its plant contents to the particular needs of the Data Centre and day
2. To add on further containers once the Data Centre grows to its final day scheme.

Standardisation within reasonable constraints is the key objective given that no two Data Centres are the same and few countries adopt the same standards.
Covering factors which would change the contents of the container can comprise:

1. Particularising the size and duty of the plant within the container, to the unique Data Hall requirements
2. Designing the contents of the container particular to the Data Centre
3. Adopting the correct local national standards, to the county of destination for the Container
4. Ensuring the containers plant is design to retro-fit and be modularised considering the Data Centres future growth when applicable
5. And, to ensure the container fits the allocated space for the Data Centre and that is contents are fit for purpose for that space.



PM Ballyshannon view from within container

KEY FACTORS

The merits of the containerised solution require the following key factors to be implemented to achieve success with the approach:

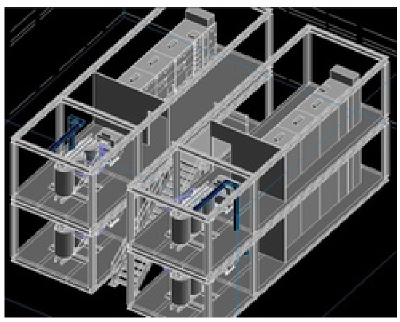
1. The relevant design experience is needed for Data Centres in Europe. Electrical, Mechanical and IT experience.
2. Customer preference and localisation for the procurement of materials
3. Local knowledge of the appropriate standards applicable to the European country of destination to be adopted in the design.
4. Engineering knowledge as to whether the end client's container has been designed to that client's brief
5. Source of replacement materials and equipment at the country of destination
6. If unique knowledge of the Data Centre itself, including supporting utility requirements, voltage, tier level, point of connections, size and capacity requirements.
7. Local ventilation, cooling and heating needs for the container.
8. The transportation needs and size of the container

Other key factors comprise:

9. Design and manufacture lead in time to build the container and its complex contents.
10. Understanding the sensitivity and protecting the equipment enclosed during transportation
11. Market Value. Going to the market and tendering against a specification major equipment within the container.
12. Having optional containers for:

- UPS Stand Alone Container Solution. To house, EATON or Schneider or Any other static UPS supplier.
- UPS, LV Switch-Room and Transformer Container Solution. Correct voltages to the Data Centre
- LV Switch-Room, Transformer and MV ring switch Container Solution.
- MV Switch-Room Container Solution
- Bottle storage Container
- MMR room option
- Security room option
- Dedicated LV Switch-Room Container
- Generator Container
- Pump and Header Container
- Cooling plant Container

5. Being able to double stack containers, consider weights
6. Adopting a Container so it has a sustainable solution such as PV, Air Source Heat Pumps or Battery Farm.



Double stacked container arrangement to save space which can be given up to increase white space for the Data Centre

POWER CONTAINERS

To summarise the Power Containers can have MV switchgear/LV switchboards, ATS, UPSs with batteries transformers, and panel boards. In addition, support systems such as lighting, security, cooling may exist in the module for enclosed form factors

SAMPLE POWER CONTAINER DESIGNS

- THE STAND-ALONE UPS CONTAINER SOLUTIONS

The UPS container below is designed to allow the customer to increase the UPS coverage by adding a UPS module easily and effectively during the growth of the white space power demands. Designing the container to anticipate future demands is a key feature of a modern Data Centre.

- UPS, SWITCH-ROOM AND TRANSFORMER CONTAINER SOLUTION

Knowledge of where the transformer container fits in with the overall scheme is important when sizing the transformer and associated electrical distribution systems. The detail below indicates a static transfer switch solution with distributing containment, bus-bars and external services connections considered.

- DOUBLE HEIGHT UPS/ BATTERY ROOM/ LV SWITCHROOM AND TRANSFORMER CONTAINER

To double stack the containers alongside the switchboard manufactures and UPS suppliers' requirements gives a viable workable retro-fit electrical plant room solution in one area. Repeating the configuration then gives redundancy where it matters.

- 3D DESIGN OF CONTAINERISED SUBSTATION & SWITCHBOARD SOLUTIONS

It is important to establish the 3D visualisation of the containers with contents showing how practically maintenance and build can be achieved

GREEN CONTAINERS SOLUTIONS

SOLAR PV CONTAINERS

Sustainability is fast becoming a major requirement for new project constructions around Europe and therefore, having an energy solution is increasingly becoming a market demand. A solution is to adopt a PV Array for Lighting. The proposal is to provide a PV array on top of containers to serve a lighting battery system for external and internal LED lighting

POWER GENERATOR TECHNOLOGIES IN CONTAINERS

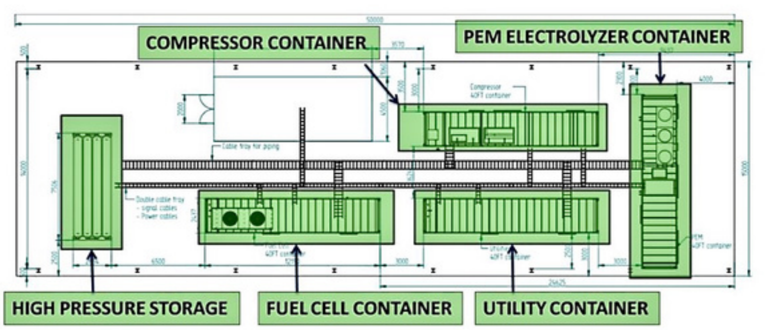
As an alternative power source technology are available or are being developed which lend to a Containerised solution being adopted.

- Hydrogen Fuel Cells stand alone
- Lithium Ion Battery Farm
- Liquid Air Battery

To evaluate these options the following criteria is assessed when considering the power emergency power source technologies:

HYDROGEN FUEL CELL CONTAINER

The hydrogen Fuel Cell technology is a consideration in terms of viability.
A typical plant layout of Containers for fuel cell technologies is indicated below.



It should be noted that this technology has many different approaches. The general advantages, if adopted relate to the green energy provided by this system. While reliability can be considered as good, from a data centre perspective, a single scheme does have well establish single points of failure meaning that multiple plants and fuel storage tanks would be needed.

LITHIUM ION CONTAINER-FARM

Lithium Ion energy storage systems to support the final day data centre could be used as a container solution.
A battery farm effectively extends to emergency back-up time for the UPS from 10 mins to 24 hours depending on the space allocated for storage.

LIQUID AIR BATTERY CONTAINERS

Construction work has begun on Technology provider Highview Power's 50MW / 250MWh liquid air energy storage (LAES) facility.
Using a solution the company has dubbed the 'CRYOBattery'. The project is being developed by the company together with UK-based independent power station developer Carlton Power and is to enter into commercial operation in 2023, to generate revenue through the Capacity Market, grid balancing, arbitrage and ancillary services such as frequency response and voltage support.

ISO CONTAINERS

ISO containers are standardized re-usable steel shipping enclosures, designed for safe, efficient, and secure storage and movement of materials from one form of transportation to another (i.e. ship to rail to truck). There are a number of ISO standards that regulate many aspects of freight containers from the classification, dimensions to corner fitting specifications, to hooks for lifting the containers, to the markings/identification on the container. These standards make transportation and handling simpler and more convenient.

Standard footprints of these containers for use as data centre modules are: 20 ft x 8 ft (6.10 m x 2.44 m) and 40 ft x 8 ft (12.2 m x 2.44 m). The 20 ft (6.10 m) containers come in a standard height of 8 ft 6 in (2.591 m), and the 40 ft (12.2 m) containers come in either the standard height of 8 ft 6 in (2.591 m) or the “high bay” height of 9 ft 6 in (2.896 m). Generally, the high bay containers are used, as they provide greater flexibility for equipment placement within the module.

DATA CENTRE CONTAINERS

A micro data centre is really a specific type of fully prefabricated data centre but is being highlighted as a separate configuration because of its unique characteristic of having all of the components co-located in a single structure. It is a self-contained, secure computing environment that includes all the storage, processing and networking required to run the customer’s applications. It ships in a single enclosure and include all necessary power, cooling, security, and associated management tools (DCIM).

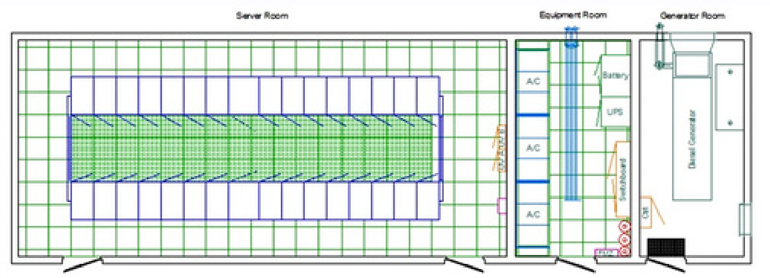
Microdata centres are generally implemented when

- A real-time or near real-time data processing need exists. For example, factory automation (e.g. robots), industrial automation (e.g. cranes), etc.
- A temporary need exists such as for military use, sporting or another temporary event
- Mobility of the data centre is important
- A remote branch site requires a small data centre, less than 150 kW
- A small data centre is in a mixed-use facility and desires ownership and control of all functions
- A data centre will be located in a harsh environment like an industrial application, an oil rig, etc.
- A small disaster recovery data centre is needed

CONTAINER PROJECTS

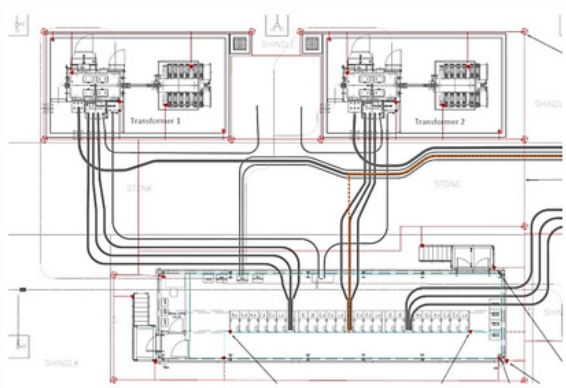
CONTAINER PROJECT A

Our project Turnkey Container Solution adopted a server room, equipment room and generator room



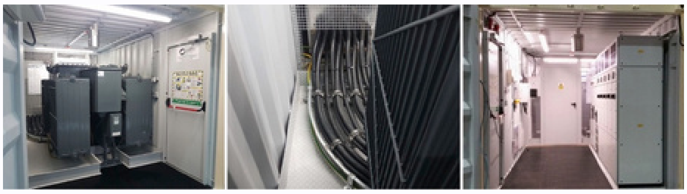
DATA CENTRE B

The layout shown below indicates a 33kV transformer connection to a containered MV substation (Switchroom) distribution to a Data Centre.

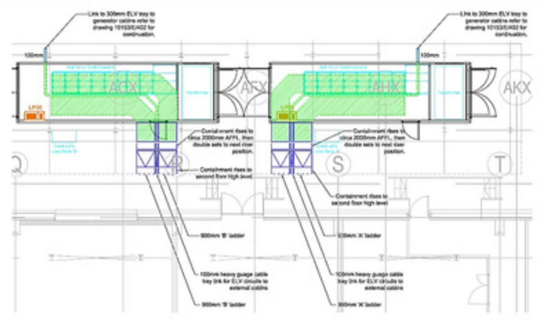


DATA CENTRE C

The photographs below indicate a Data Centre with a particular specification for Midel transformers along with LV distribution switchgear serving the remote UPS equipment.

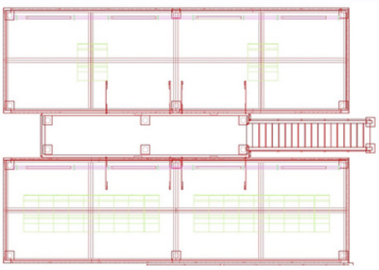


The drawings below show the design for the same transformer and LV switchboard configuration alone with external positioning of electrical containment systems.



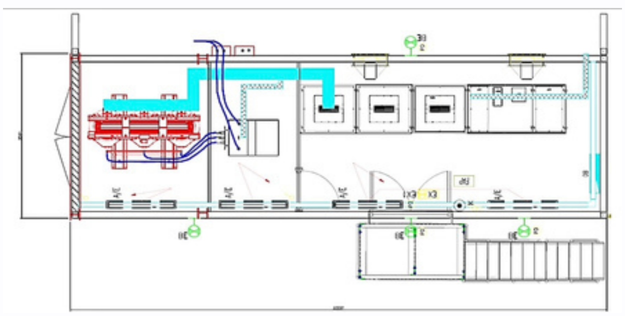
DATA CENTRE D

The photographs below indicate how demountable 11kV switchgear is containerised as a retrofit solution to serve a large Data Centre power need of around 20MW. With the specialist design knowledge needed for MV Containers, power distribution hubs are achieved in the drawing below.

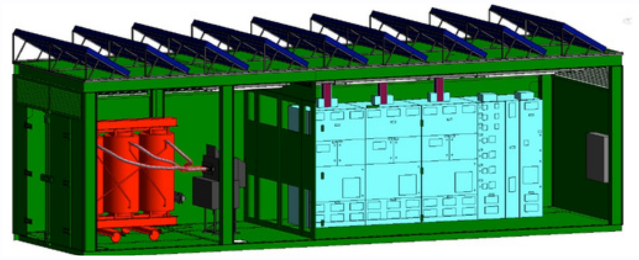


DATA CENTRE E

The standardisation of the containers allows for rollout and a simpler one size fits all is the objective to save costs and speed up delivery. The drawings below indicate how a simple concept can achieve this model of delivering a standard power container solution

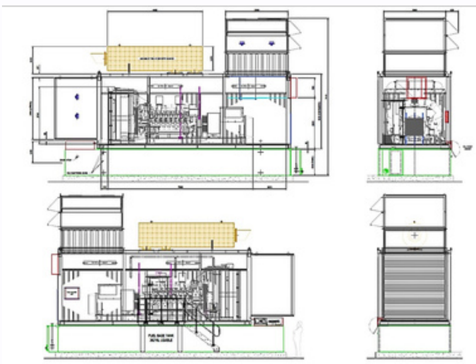


3D image gives the observer a realisation of the target container to be achieved



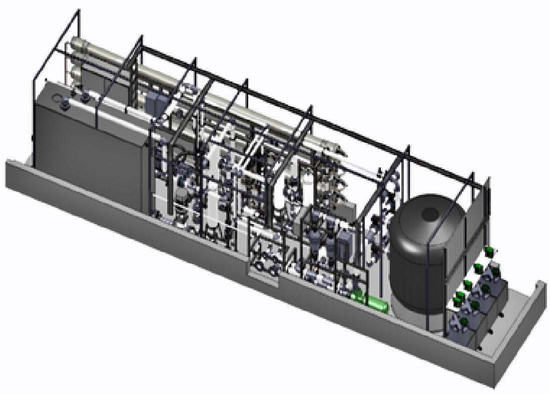
DATA CENTRE F

Generator Containerisation
The generator size and footprint have been selected to fit the space permitted with a short length container as shown.
Containerised Generation enables the simplest and fastest generator solution to be delivered to the data centre.
The method of providing containers with generators allows a modular generator approach for flexibility for the Data Centre.



DATA CENTRE G

Containerised pump and conditioning plant solutions, are adopted to a particular specification designed according to the client's needs



3D realisation of the plant is shown before build to enable approvals to a design

PREVIOUS PROJECTS

Virtus Data Centre programme software amendments to a Siemens relay, to enable the transformer inrush protection to work correctly.

KIPO was appointed by Global Switch to provide a detailed protection and discrimination study for the 50kV/ 10kV/ LV distribution systems (21MW).

- The study included UPS and DRUPS protection schemes, short-circuit power flow reviews, relay specification and high voltage installations.
- The integration of 2 x 5MWe 11kV generators with 3 existing generators for the data centre.
- Analysis of the generator cause and effect, the consequences to protection, the need for additional directional protection and to prevent nuisance under-voltage relay tripping.

UBS bank with design and corrective application to three data centres in Canary Wharf in London.

Didcot Data Centre with Network Rail, providing a detailed design solution.

We were appointed to provide a coordination study on Colt's Data Centre in Welwyn Garden City. We provided a study on Medium Voltage Design aimed at maximising system reliability and availability, and ultimately assessing how to improve power quality.

China Mobile International Data Centre project which included providing a Protection Co-ordination Study that complied with IEC 364 and EN 60909:2016. We supplied a report for implementation of MV and LV, which would include for the Time Current Graphs, as well as Short Circuit Analysis.