

CASE STUDY

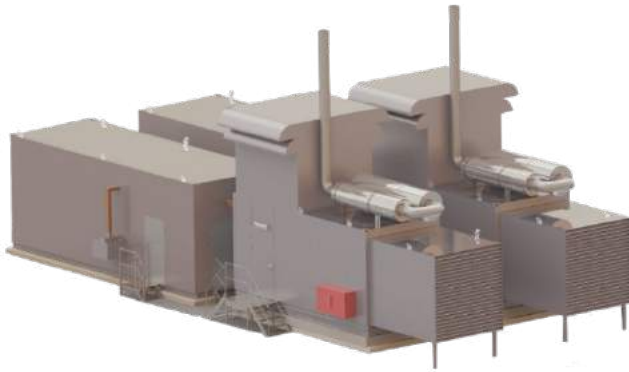
ROYAL CHESTERFIELD HOSPITAL



CHESTERFIELD HOSPITAL CASE STUDY

Project Overview

Chesterfield Royal Hospital NHS Foundation Trust provides general acute services for a population of over 400,000 to people living throughout North Derbyshire and beyond. To provide some measure of its capacity, Chesterfield has 15 wards and over 500 beds, in the year to the end of March 2023 it looked after over 32,000 people following planned operations, nearly 300,000 people were seen in outpatient clinics, treated more than 100,000 people in the A&E unit, all delivered by over 5,000 staff and volunteers.



WB Power Services were awarded the opportunity by the Foundation Trust to specify, design and install a standby power solution for the hospital, providing vital back-up power for the facility in case of a power failure.

This case study looks to fully explore the innovative “one stop shop” packages that WB Power Services have been able to offer this client. From project design, providing optimised transformer and switchgear solutions, customised Kohler generating sets

and associated control systems and WB’s Principal Contractor package which includes all electrical installation and civil works.

Fig 1 Design graphic prepared for client

The early design brief issued by the client sought for the replacement of two key substations, backed by standby generation complete with mains generator changeover, load bank connection point and output LV switchgear. Additionally, the generators were to be configured such that either generator could feed the other package and hence building. The package there included:-

- Two package substation (one for each building)
- Provision of N+1 standby generation
- LV Switchgear
- Electrical Installation
- Development of control system philosophy and associated system software development
- Civil works
- Full design and project management of the site and associated works

With power densities continuing to increase the client wished to minimise the overall footprint of each substation and generator package.

Generator Selection

Working closely with the client we identified that a 1000kVA 800kWe prime (PRP) rated generating set offered the optimum capacity and flexibility to meet their current and foreseeable needs. WB matched this requirement to our partner Kohler's KD1100. When married to the appropriately rated Kohler KH03860T alternator the Kohler compact, fuel efficient, power dense and highly reliable 12-cylinder, 27 litre KD27V12-5DES engine can comfortably deliver the full power required. The sets were provided with a dual battery, dual battery charger and dual starter motor arrangement for enhance starting reliability and a 200-hour lube oil make up tank to ensure safe long term continuous running of the sets.



The two generating sets were housed in their own custom-made acoustic containers rated to achieve a noise level of 65dBA @1m FFC (both sets running) and came complete with fire detection, fuel shut off valve and all internal lighting and ventilation. To minimise the footprint of the entire package the container housing the generator was designed to accommodate a penthouse style inlet and horizontal discharge

arrangement. The dual roof mounted exhaust gas silencers were arranged for high level vertical discharge.

Fig 2 Generator package in production

The key adaptation for these sets was the addition of a dual output circuit breaker package which was designed to facilitate the traditional load breaker and local LV load bank testing for each individual set.

The generating sets were deployed in an N configuration with typically one generating set dedicated to feed its own building within the site.

Generator Control System

The client expressed a preference for the use of a ComAp control system on both the generating sets and switchgear. The generating sets therefore utilise the ComAp Intelligen system configured for soft mains return.

The ComAp control system also offers a comprehensive range of remote monitoring / status interface options which include RS485 and Modbus etc which are available via volt free connections, ethernet or fibre optic connections. In this application the generating sets are connected to the onsite BMS system.

Fuel System

To reduce the overall footprint of each package it was decided to move away from the more conventional day tank, bulk tank and fuel distribution system. A “structural belly tank” solution was developed that would sit under each generating set. The tanks were sized at 5,000l (24 hours full load running) usable capacity to meet the client’s operational requirements can come complete with a fuel fill point and fuel polishing system.

Transformer, Switchgear Containers and Switchgear Control System

The total package provided for the replacement of two substation each of which feeds a building within the hospital campus. As with the generator containers the two substation/ switchgear containers were also identical.

Each of the switchgear containers is fitted with

- 1 x Schneider Electric SN6-S1-21 630A non-extensible switch disconnecter
- 1 x 1000kVA ANAN 11kV/417V (no load) aluminium wound energy efficient cast resin Transformer with, temperature relay & PT100 sensors
- 1 x Schneider Electric MTZ1 06 HA 630A 3P neutral earth device
- 1 x tripping batteries
- 1 x 1600A rated form 4 type 6 distribution board with
 - Mains / Generator change over
 - Load bank connection point
 - A mid busbar section switch splitting the outgoing distribution ways into essential and non-essential elements
 - An end of line interlocked bus section switch allowing for interconnection between boards in both panels designed to permit either generator to feed the essential load of the other board / building
 - Connection for power factor correction equipment
 - Power monitoring on all incoming and out going ways
- All key motorised circuit breakers managed by a ComAp controllers
- Provision of ComAp schematic display panels and HMIs located at key points throughout the system
- External link box for connection of temporary generating set

The Transformer section is a naturally ventilated IP2X sheet steel enclosure complete with double access doors and fitted with Castell lock to prevent unauthorised access.

Additional ComAp controllers were installed within the switchgear panels to manage the mains / generator changeover, generator soft mains return and control of the two bus section switches. By creating an essential and non-essential sections within of the LV board the client is able to full manage the generator load and operational configuration of the generating sets. Using the full functionality of the ComAp units to control the bus section switches means that either generating set can, if required, provide power to the essential sections of both distribution boards adding that essential redundancy so important in critical healthcare settings.

Containers

All containers were fitted with internal and external lighting (with some emergency fittings), heating and ventilation (as required) to ensure all operations requirements of the installed equipment were covered. Additional safeguards were also put in place with the use of internal bulkheads assess to which were controlled by key interlock systems, fire alarm panel, smoke detection and associated warning lights and beacons.

The generator and switchgear containers were levelled to ensure that roof heights match. This allowed for duct work and cable access from below to the two switchgear containers. Busbar flange connection to manage the busbar interconnections between the generator and switchgear enclosures

Civil Works

The civil works associated with the project formed a significant part of the overall works and included elements such as

- Excavations to max depth of 1.5m to level the site plus material disposal and compacting excavated area
- Earth works supports to 4m depth
- Back filling and levelling for structural bases
- Construction and forming of service ducting / trenching
- Provision and installation of ducting and piping for surface water drainage
- Excavation and installation of land and channel drains including brick and concrete surrounds for manholes etc with connection to existing drainage system

Mechanical Installation

The mechanical works also formed a major part of the works and included such elements as:-

- Site survey and builders work installation and coordination drawings
- Prestart investigations and tests
- Identification and removal of redundant services
- Management of domestic water and gas supplies

Electrical Installation

As well as providing a full suite of electrical services within each of the containers WB undertook, as part of the installation package, the provision of all of the power, control and interface connections between the containers. Power connections being provided in busbar.

In addition to provision of the inter container connectivity WB undertook the provision of some of the following:-

- All prestart inspections and drawing validations
- The making safe, disconnection and marking up of redundant electrical equipment to permit stripping out
- The stripping out and removal from site all redundant equipment
- The provision of High Voltage works
- The provision of undertaking the whole G99 DNO Connection process and implementation of protection settings including all testing and witnessing
- The provision of a new below ground earthing installation and associated earth bonding
- The provision of new sub mains distribution installation

Testing and Commissioning

All four containers underwent a series of factory acceptance tests prior to being delivered to site. Providing modular packaged solutions of this type means that much of the testing can be completed before delivery cutting down site installation and commissioning time.

Design and Project Management

Having received the initial design brief from the client WB worked closely with its partners and the Trust to provide a fully developed design before proceeding with production. Close liaison with the Estates team at all stages ensured that the packaged solution met with the brief and operational requirements of the hospital.

One method WB adopt in this type of project is to ensure that its project managers are involved at an early stage in the development of any design. This works to ensure that we fully utilise their wealth of practical onsite knowledge the PM has such that they both contribute to the design and have a clear understanding of the project once it goes to site for installation.

WB were awarded the project as Principal Contractor and as such took on all responsibilities required to fulfil that role which include, taking full responsibilities for control and management of the site area, Health and Safety, staff inductions, welfare facilities, site security and all temporary service etc. A full site management team was put in place which included contract manager, project manager, QS, HSEQ inspections etc

