Innovative circuit breakers for Oxford's largest hospital

Mike Porter, Business Development Manager at electrical distribution and control specialist, Electrical Distribution Solutions, who has 'a wealth of knowledge on switchgear' gained throughout a lengthy electrical career, describes a project undertaken in very rapid time, with minimal disruption, at Oxford's John Radcliffe Hospital, to replace obsolete low voltage air circuit breakers with retrofit variants, which will significantly extend the life of the existing switchboard at a cost of under one-third of a new switchboard.

Oxford University Hospitals NHS Foundation Trust provides a wide range of clinical and specialist services – which include cardiac, cancer, musculoskeletal and neurological rehabilitation, as well as medical education, training, and research. It says that 'collaboration with the University of Oxford underpins the quality of the care we provide to patients'.

As of the end of 2020 the Trust had 1,133 beds – which included 946 general and acute beds, 79 critical care beds, 18 for rehabilitation, and 90 for children. With 58 inpatient areas, 48 operating theatres, and 11,904 staff at that point, the Trust has over 1.5 million patient contacts annually, and serves the growing populations of Oxfordshire, Buckinghamshire, West Berkshire, Northamptonshire, and Wiltshire, although patients come from even further afield for specialist procedures.

Electrical switchboard issue

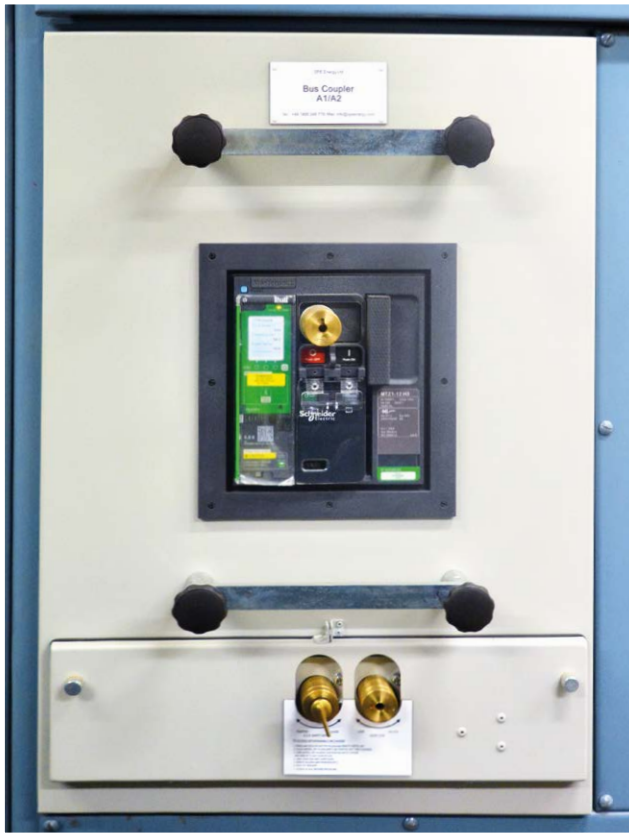
The power required by the Trust's largest acute healthcare facility, the John Radcliffe Hospital in Headington – Oxfordshire's main Accident and Emergency site, which provides acute medical and surgical services including trauma, intensive care, and cardiothoracic services – is distributed at 11 kV through a network of high voltage cables to four sub-stations, where it is transformed down to 415 V for further distribution into the hospital buildings. Each transformer feeds a main low voltage distribution switchboard, which were manufactured by Ottermill, which ceased trading many years ago. The switchboards date back to 1974 and are now obsolete. The unavailability of spares, and the low voltage air circuit breakers becoming problematic, gave rise to major concerns over the reliability of supply, and the Trust's Estates Department faced the dilemma of how to maintain reliability and continuity of supply with obsolete switchgear.

Space constraints

Consideration was given to replacement of the complete switchboard, but with space limited, and with the Trust not willing to see the electrical distribution system put at risk – a potential scenario being one transformer isolated in order to install a new low voltage switchboard, the customer looked for an alternative, innovative solution. I thus met with Mark Martin, the Trust's Operational Estates project manager, to discuss and gain an understanding of the operational issues and constraints faced by the hospital. Upon completion of a joint site visit, Electrical Distribution Solutions proposed and tendered a solution.

The joint site visit between the hospital Estates Department and Electrical Distribution Solutions revealed that the

Oxford's John Radcliffe Hospital in Headington is the Oxford University Hospitals NHS Foundation Trust's largest hospital, and Oxfordshire's main accident and emergency site.



The original Ottermill low voltage air circuit breaker in its withdrawn position (left), and an EDS Ottermill retrofit such circuit breaker (right).

An EDS retrofit low voltage air circuit breaker replacing the Ottermill type OMA24 bus-section.

fixed portion of the switchboards was in very good condition, and suitable for continued operation.

With-ever increasing financial pressure facing Oxford University Hospitals NHS Foundation Trust, Electrical Distribution Solutions was able to offer an innovative, technically sound, and cost-effective retrofit solution.

Extending existing switchboard's life

The proposed solution was to replace the obsolete low voltage air circuit breakers with retrofit low voltage air circuit breakers, which would significantly extend the life of the existing switchboard at a cost of much less than one third of a new switchboard.

The retrofit solution negates the requirement for complex planning, civil, cabling, and cable jointing/termination, and extended periods of time where the hospital electrical distribution system would be at risk.

The Electrical Distribution Solutions retrofit low voltage air circuit breaker utilises a modern air circuit breaker which has been engineered to directly fit in place of the old low voltage air circuit breakers without, in most cases, the requirement for a busbar outage. All interface points, such as contacts and interlocks, are identical and operate the same way as the old circuit breaker. The retrofit circuit breakers incorporate a modern intelligent electronic device which affords much improved functionality. It allows enhanced grading with upstream and downstream protection devices, along with remote closing, opening functionality, and metering facilities, which can be incorporated into the Trust's building management scheme.

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The project at John Radcliffe Hospital involved the replacement of 14 low voltage breakers, as follows:

- Four Ottermill OMA 12 50 kA, 1250 A, incoming ACBs.
- Two Ottermill OMA 12 50 kA, 1250 A, Bus coupler ACBs.
- Five Ottermill OMA 25 50 kA, 2500 A, incoming ACBs.
- Four Ottermill OMA 25 50 kA, 2500 A bus coupler ACBs.

Installation considerations

As with undertaking any work on an electrical distribution system, of paramount importance is health and safety. Guidance for electrical compliance in the NHS is the HTM 06-02: *Electrical safety guidance for low voltage systems*.

Of equal importance when undertaking this work on the John Radcliffe Hospital distribution system was that, where possible, we should maintain the N+1 requirements as set out in Health Technical Memorandum 06-01: *Electrical services supply and distribution (2017 edition)*.

As the project involved the replacement of incomers and associated bus couplers, in theory both transformers being of the same phase rotation would allow the bus coupler to be closed before the incomer is opened. The John Radcliffe Hospital distribution network was operated with both incomers closed and the bus coupler open. This has been the case for many years. In order to utilise this arrangement, it was necessary to undertake tests to ensure that both transformers were in phase. Having undertaken testing and proven that the transformers associated with each switchboard were in phase, it was now clear that the system's N+1 status could be maintained throughout the installation work, thereby maintaining continuity of supplies to all parts of the hospital – to the extent that very few, if any, hospital staff were even aware of the major work being undertaken on the electrical distribution system. Thanks to Mark Martin and his team, all Permits to Work and Sanctions to Test were issued promptly and very professionally,

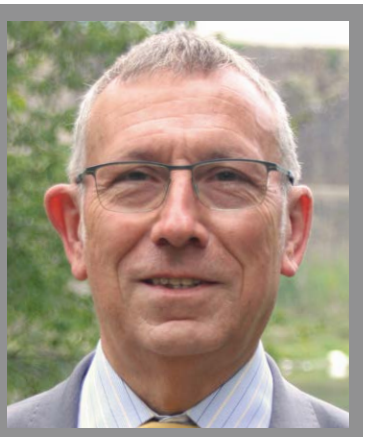
allowing the entire works to be completed in one eight-hour shift.

Getting equipment to site

One of the more mundane issues to be considered – given that the John Radcliffe Hospital is an extremely busy acute healthcare facility, with heavy staff, patient, and visitor traffic – was the delivery of the equipment to site and to the different substations. To mitigate any risk associated with transporting and lifting of large plant, it was deemed best practice to deliver the equipment to site in the silent hours.

The Trust's Mark Martin said of the project: "I have completed similar replacement projects in the past, in previous roles. The amalgamated team of Electrical Distribution Solutions and SPE Energy worked flawlessly, and proved one of the best teams to work with. On the day of the changeovers the combined resources, along with my hospital team, worked tirelessly together to ensure that safe working and supplies to all areas were uninterrupted. We also maintained our N+1 resilience at all times. The project's 's successful completion also gives us the ability going forward to parallel up our transformers, so we can 'make before break' if we need to switch to alternative supplies. The technical ability of all staff was exceptional, and the installation was completed within a single day." hej

Mike Porter



Mike Porter, appointed on a part-time basis as Business Development Manager for Electrical Distribution Solutions in February 2021, brought to the role 'a wealth of knowledge on switchgear' and many UK and overseas contacts. He says of his career to date: "On leaving school, I secured an apprenticeship with South Wales Switchgear as an electrical technician, gained a sound grounding in engineering practice, and considerable knowledge of the principles of High Voltage switchgear. On completing my apprenticeship, I worked as an electrical technician in the Test and Certification Department at South Wales Switchgear, followed by a three-year spell as a Design Draughtsman in the Switchgear Design Department – where I was involved with the detailed design of switchgear, overhead stack-bridge dampers."

His next role was as Senior Electrical Authorised Person responsible for the high voltage distribution network at RAF St Athan in the Vale of Glamorgan, where he gained practical experience in the installation, maintenance, testing, and operation, of HV switchgear and transformers installed in a distribution network, including switching, and issuing of Permits to Work and Sanctions to Test.

He later moved into business development in the switchgear industry, as Area Sales Manager for the South Wales and the South-West with GEC Alsthom. On the sale of GEC Alsthom and a re-organisation, he became Key Account Manager with AREVA responsible for South Wales Electricity Board, Southwestern Electricity Board, Midlands Electricity Board, East Midlands Electricity Board, Guernsey Electricity, and Jersey Electricity. His next role was as a National key Account Manager for the rail sector, which included Network Rail, London Underground, and all consultants and contractors involved in the electrification of the rail network. He said: "My last full-time role was as Sales Director for switchgear designer, developer, and manufacturer, SPE Energy, responsible for both UK and export sales."