

Electrifying London

Underground cable connects substations to placate London's insatiable demand for power

Stephen Trotter

ABB is helping to secure London's power supply for many years to come. Recent projects completed for National Grid on London's power infrastructure have provided a 20 km long, high-voltage, underground cable link, together with two major new GIS (gas insulated switchgear) indoor substations – all to help satisfy the capital's fast-growing demand for electricity.

Demand for power continues to increase throughout the UK, but in London, the rate of increase is around twice the national average. Projections indicate that this growth rate will be sustained for at least another 10 years. Since 1990, to ensure the future of London's power supply, National Grid has invested over Euros 1,000 million (\$1,270 million) in the reinforcement of the transmission network in and around London. This represents approximately 20 percent of National Grid's total capital investment in the whole of England and Wales.

One of the measures taken by National Grid was to commission ABB with a three-year turnkey project, to be completed in the summer of 2005. The project was to create the "London Connection" to meet electricity de-

mand in the capital and the area north west of London.

The "London connection"

Running in a 20km long three-meter diameter tunnel, the cable links an extended substation at Elstree to a substation built by ABB at St John's Wood. It was the largest tunneling project that National Grid has ever undertaken.

The "London Connection" uses high-technology, low-maintenance cross-linked polyethylene (XLPE) insulation technology and is currently Europe's longest 400-kV XLPE underground cable ¹. A similar underground cable was installed by ABB in Berlin in 1998.

For the London project, ABB installed, commissioned and tested 61 km of

150-mm diameter cable, weighing a total of 2,440 tonnes that was delivered on 63 massive drums ².

St John's Wood substation

In addition to meeting the generally increased power demand for the capital, there was a specific need to upgrade the existing St John's Wood substation in West London to cope with extra local demand.

National Grid therefore decided to build a complete new substation at St John's Wood. Even though there had once been a power station at the site, there was very little non-operational space and since land is at a premium in this part of London, there was no way of purchasing any extra space. So the new 18-bay, 400-kV substation had to fit onto a footprint of just 90 m by 30 m.

In order to minimize the visual impact of the substation on the local community, and to contain the equipment within such a confined area, ABB's state-of-the-art compact gas insulated switchgear (GIS) technology was used ³.

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As the main contractor, ABB was responsible for all aspects of the St John's Wood project, including the decommissioning of the old plant, installation of the new plant, refurbishment of remaining old plant components and interfacing the old with the new. Because of the lack of "lay-down" space on site, very careful planning was required. Deliveries had

1 ABB 400-kV XLPE underground cable



to be coordinated on a "just-in-time" basis and accommodate all the extra complications of working in a congested residential area. Some idea of the scale of the undertaking is given by the number of vehicle movements on the site: 200 vehicles were needed for the GIS equipment alone, and nearly 7,500 for the civil works.

GIS switchgear

The switchgear installation at St John's Wood is currently the largest 400-kV GIS substation in the UK. The ABB equipment is designed to minimize gas leakage, and monitoring for gas leaks can be performed both locally and remotely.

In the rare event that maintenance or repair is required, the switchgear design maintains maximum system availability by requiring only the affected components and bay to be switched out.

The constraints on the height of the building were met by constructing a six-meter deep basement below the switch-house.

Autotransformers

Four ABB autotransformers (240-MVA, 400/132-kV) were installed to reduce the voltage of the electricity in order to feed the local substations. The massive transformers, each weighing 171 tonnes, were brought by sea to the London port of Tilbury. To minimize disruption to traffic, each transformer was moved to the site during the early morning (see title picture). Street furniture had to be removed along the route and certain sections of roads and bridges had to be strengthened to take the weight.

Control and protection

The substation can be controlled remotely from National Grid's UK Control Centre in Wokingham. A standby control room also allows local supervision of the substation and tunnel, including switchgear, protection, power measurements, building systems and security. Fiber

optics is used as the main communication medium to support high data transmission rates with immunity to electrical noise. All the equipment is synchronized to absolute time using GPS (global positioning system) technology.

Local community

The ABB site team worked closely with National Grid in order to maintain a good relationship with the local community. For example, mail drops were carried out to around 1500 local addresses to keep residents informed of major activities such as pile driving or deliveries of heavy loads. There was also a 24-hour call center for concerned residents. ABB responded quickly to solve any problems. This attention to detail included a swift response when the erection of the 30-m tower crane affected TV reception for a few residents.

Very high standards of health and safety were observed throughout the project and, in 2004, ABB was awarded a certificate for the successful com-

Ingenuity and energy

pletion of 250,000 hours with no time lost due to injury.

City Road North

While one ABB site team was busy in West London, another team was hard at work on the other side of the city creating National Grid's new "City Road North" substation. This contract was part of the urban regeneration of the City Road canal basin in Islington, North London.

The new City Road North substation, which was constructed adjacent to the existing City Road substation, is a key part of a program by the local utility,

EdF, to reinforce the power grid serving the North London area. The substation is housed inside a new brick building, designed by Markwick Architects, to minimize its visual impact on the area. This was in line with Islington Council's redevelopment plan to improve access and recreational opportunities, thereby enhancing the local urban environment.

ABB was responsible for all engineering design and civil works at City Road North, as well as the complete installation and commissioning of the substation switchgear and ancillary equipment. The project team's first

task on site was the demolition of an existing office block to make way for the construction of the new substation. The nature of the site, in a busy inner-city site in Islington, was a major challenge. It was surrounded by residential, commercial and industrial premises, and backed on to the Regent canal. A great deal of logistical planning was required just to move heavy plant and materials in and out of the site.

The project also included diversion of an existing 400-kV cable into the new substation. The existing cable had linked the old City Road substation to the substation in West Ham, six miles away in East London, and the diversion was necessary to complete the West Ham/City Road North and City Road North/West Ham circuits.

2 ABB power cable on massive drums



3 ABB's compact gas insulated switchgear has the right footprint.



The work continues

The excellent performance of ABB technology at St John's Wood and City Road North, coupled with the company's proven ability to meet tight delivery schedules, has resulted in National Grid awarding two extension projects to ABB. These projects are currently in progress.

ABB is responsible for the engineering design and civil works of both the St. John's Wood and the City Road North substation extension projects, as well as providing a complete installation and commissioning service. The new substation protection and automation systems for City Road will be based on National Grid's standardized NICAP (National scheme for Integrated Control and Protection) philosophy. This approach enables ABB to reduce delivery times significantly by using pre-engineered, pre-tested and pre-approved solutions to swiftly integrate the new bays into the existing substation systems.

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