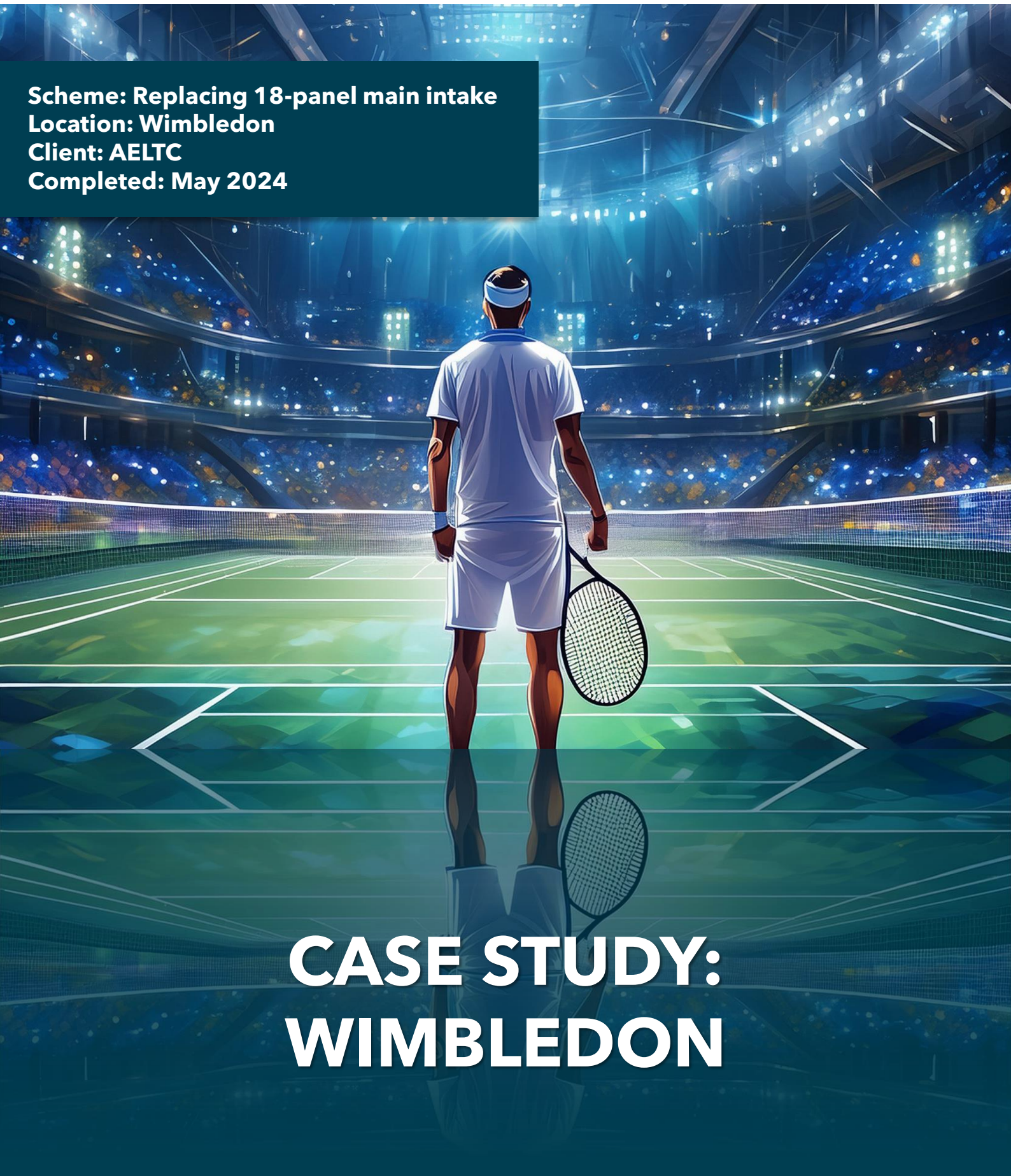
RJ POWER



Scheme: Replacing 18-panel main intake
Location: Wimbledon
Client: AELTC
Completed: May 2024

CASE STUDY: WIMBLEDON

INTRODUCTION

RJ Power Networks were instructed on a design-and-build basis to replace the 18-panel main intake switchboard in the Main Intake Substation, including the replacement of two power transformers, at Wimbledon Tennis Club. This project ran from the end of the 2023 Championships and was to be completed prior to the run-up to Wimbledon 2024.

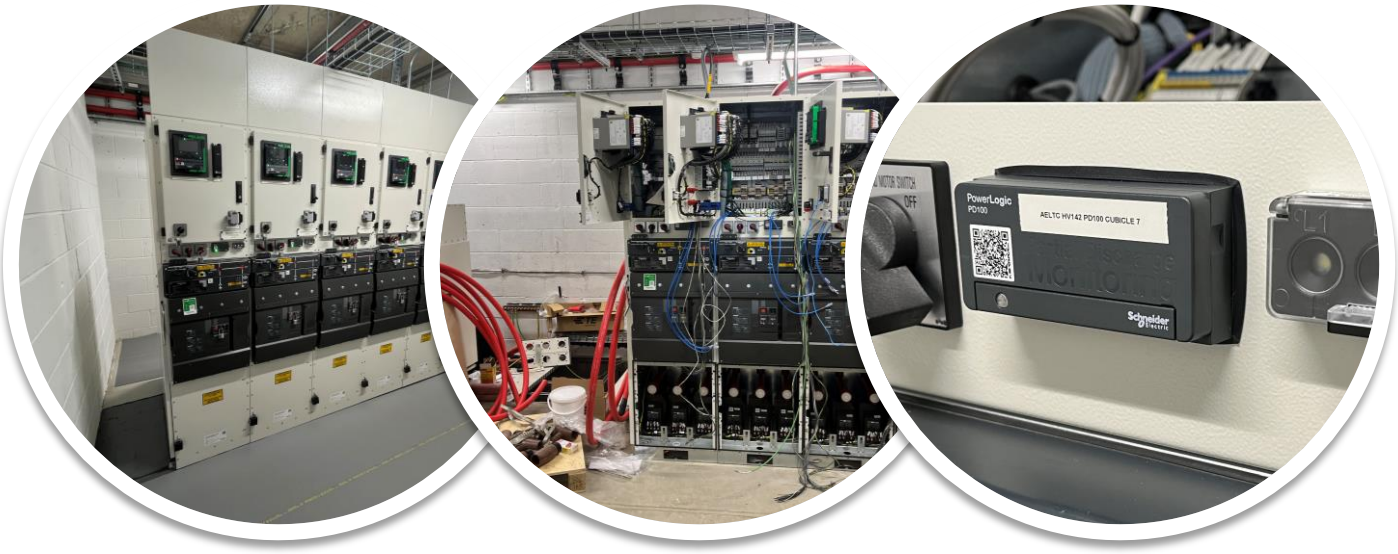
Design works were accelerated due to a catastrophic failure of the ABB UniGear 500R, resulting in a three-day outage to a large section of the site. Partial discharge monitoring was not available in the old equipment – the detection of which could have triggered an intervention to find the cause and cure it before the panel failed. Temporary HV cable diversions were carried out to restore supplies following the fault.

The initial design brief was to split the single 18-panel switchboard into four separate boards in fire segregated switch rooms, with cable-bus sections to provide security to the supply in the event of a switchboard failure. Space in the adjacent plant room was used to allow for the expansion.

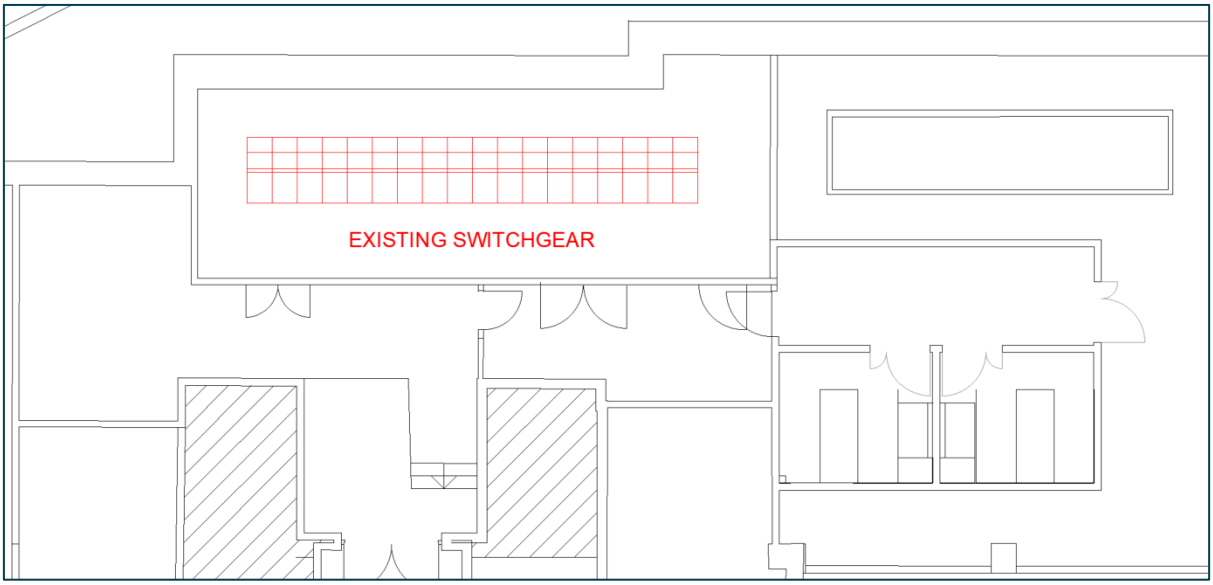
The catastrophic failure of the ABB VCB would have been prevented by employing additional protection functions which were available from the existing protection relays but not utilised. This was of key concern during design of the new protection systems.

Works included in the project, managed by RJ Power Networks acting as **Principal Contractor** and **Principal Designer**, were as follows:

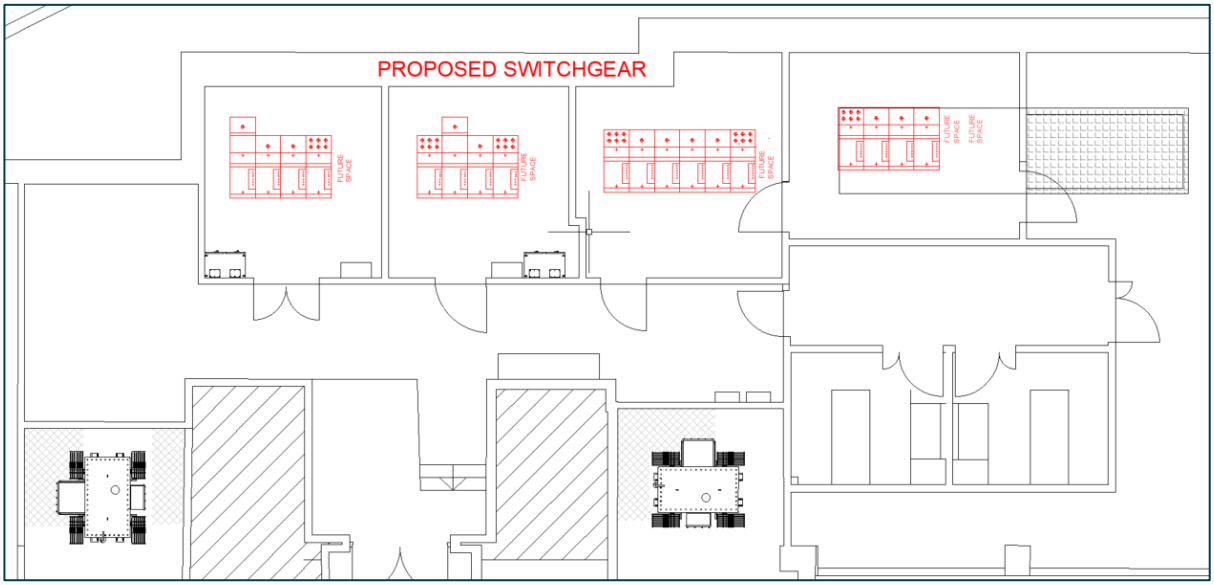
- Full project and design management
- Decommissioning of the redundant system, including the SCADA and DC systems
- Installation of the new 11kV switchgear
- Installation of the new DC system
- Containment and cable installations
- Renewal of small power and lighting (by client incumbent subcontractor)
- Design, supply and installation of new SCADA critical control system (by client incumbent subcontractor)
- Full commissioning of the system and IST to prove critical control restoration processes



ORIGINAL DESIGN



PROPOSED DESIGN



TIMESCALES

Issues

The project was under strict timescales and had to be completed prior to May 2024.

Solution

Working closely with the client and their incumbent subcontractors, and with RJ Power acting as Principal Contractor and Principal Designer, the project was delivered within the tight timescales set.

11kV SWITCHGEAR

Issues

The original four-section, 18-panel switchboard was at risk of a single circuit-breaker failure. Unfortunately, this did occur prior to replacement and accelerated the programme. A large switchboard makes it difficult to maintain, replace and work on single sections.

As the switchboard supports most of the site, replacement required temporary cable diversions to allow for full removal and installation of the system.

The protection functions of the previous switchboard were very basic and not what was required for the system. No additional protection was offered over basic overcurrent and earth fault.

The existing critical control SCADA system was not functioning and was unsupported. The full system was connected to the local area network and was vulnerable to cyber attack.

Solution

The switch gear selected was **Schneider Electric GenieEvo**. All VCBs and busbars were specified at 1250A, for system security, future capacity and for all equipment to be interchangeable for spares.

The system was split into four individual switchboards, each with a cable-bus section to the next contained within fire segregated rooms.

With the failure of the old switchgear due to partial discharge, and the protection taking 1500ms to clear the fault, the new protection scheme was of great importance to the client. **Schneider Electric PowerLogic™ P5F30** relays were specified throughout, providing the following functions:

- Full, multistage plain and direction overcurrent, earth fault and power protection
- Logic blocking scheme across the whole network, for any configuration
- Arc-flash light detection, operating over IEC61850 GOOSE messaging, providing high-speed protection of the circuit breaker, busbar, and cable compartments
- Circuit-breaker fail protection, which would have avoided the catastrophic failure of the old switchboard, is installed throughout
- Intertripping to all DNO and remote ends for full clearance of faulted zones

In addition to the protection functions, integral partial discharge and thermal sensors were installed and connected to the **Schneider Electric EcoStruxure Asset Advisor**, with all relay and metering data provided via the secure SCADA system for cyber security purposes.

With cyber security in mind, each switch panel was hardwired to a new local SCADA system for critical control. A separate non-critical PLC, not directly associated with the critical control PLC, is used for collecting all other data from the P5 protection relays over RS485 communications. No direct connection via ethernet to the relays was permitted, thus securing the system.

DC SYSTEMS

Issues

The previous installation of one 18 panel switchboard was supplied from one single 110-volt battery charger with no redundancy. This was of key concern during design, as a failure of DC systems renders the entire system inoperable.

Solution

The design brief for the new DC system was n+3, with battery charges located in different fire segregated rooms and in fire segregated compartments. Each of the four switchboards has two parallel DC supplies, with each supply coming from a dual-fed DC distribution board. This arrangement leaves the ability for one single battery charger to support the entire system with no interruptions to DC supplies.

Valve-regulated lead acid batteries were specified, with four sets of batteries, each being replaced at two-year intervals, leaving the HV system with no battery that is capable of supporting the whole system at less than two years old. In addition, full-time battery impedance monitoring was installed, connected to the new local SCADA system.

TRANSFORMER REPLACEMENT

Issues

The original pair of transformers were critical to the running of the site. Each was 1600kVA and contained within its own housing and room. Previous issues of overheating in hot weather at 50% load and the rooms being ventilated to the outside left a dry type transformer not suitable for this application; nor could one transformer accept the full load of the other in the event of failure.

Solution

The transformers were specified at 2000kVA to allow for future capacity and emergency rating. Liquid filled units were specified to allow for better cooling, longer life and enhanced monitoring and protection abilities.

The transformers were specified with **Midel 7131** for environmental and fire protection. The units were specified with **Ashridge** winding temperature units for connection to the SCADA system. A pressure relief device with trip contact was specified to provide high speed over pressure protection. A **Schneider Electric EcoStruxure Transformer Expert** probe was installed on each to monitor temperature, water content, online DGA, and vibration and partial discharge monitoring.

Fitment in the rooms was a challenge, however **Nationwide Industrial Services Ltd** provided specialist plant movement services to move the transformers through the available openings with 10mm clearance on either side.

"I'd like to say a massive thank you from the AELTC to all those involved in the delivery of the first phase of upgrades here at Church Road. In particular, RJ Power's dedication and commitment from initial concept to install has been remarkable. Looking forward to working with the team over the next few years as we bring the club to the forefront of HV/LV innovation." **- AELTC**

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