

SUCCESS CASE 19.2026

Retrofit Programme for Medium-Voltage Switchgear REPLACEMENT OF OIL CIRCUIT BREAKERS WITH VACUUM CIRCUIT BREAKERS AND PROTECTION SYSTEM MODERNIZATION.



THE CHALLENGE

Premier Energy Distribution operated a substantial fleet of medium-voltage switchgear cubicles equipped with conventional oil circuit breakers and electromechanical protection relays. A significant share of this equipment had been in service for many years and required increasingly intensive maintenance, while spare parts and specialist support were becoming progressively more difficult to secure. The ageing technology also involved higher operational and fire-safety risks due to the use of insulating oil, longer maintenance and fault-recovery times, and limited compatibility with modern substation automation, event recording and remote-control systems. A complete replacement of the existing switchgear line-ups would have required major capital expenditure, extensive civil and installation works, long planned outages and the premature decommissioning of still-serviceable busbar systems, cubicle structures and primary connections.

THE SOLUTION

Between 2007 and 2019, Premier Energy Distribution implemented a large-scale retrofit programme for medium-voltage switchgear installed in 35–110kV substations and 6–10 kV distribution points. The programme was based on the replacement of obsolete oil circuit breakers with modern vacuum circuit breakers, while retaining and adapting the existing switchgear cubicles, busbar systems, cable terminations and primary circuit arrangements wherever their technical condition allowed continued operation.

The retrofit scope included: replacement of oil circuit breakers with vacuum circuit breakers; mechanical and electrical adaptation of the new circuit breakers to the existing cubicles; replacement of electromechanical protection relays with numerical protection relays; modernization of secondary control, indication, signaling and trip circuits; integration of auxiliary contacts and status signals; provision of interfaces required for SCADA integration and remote operation; functional testing and commissioning of the upgraded protection and control schemes. Overall, 829 circuit breakers were replaced across 79 substations and distribution points.

MAIN ACHIEVEMENTS

The retrofit approach enabled Premier Energy Distribution to modernize critical medium-voltage assets without replacing complete switchgear line-ups. By retaining the existing cubicle structures, busbars and primary connections, the company significantly reduced dismantling works, civil works, installation activities and outage durations. Compared with the complete replacement of the switchgear cubicles, the retrofit solution generated investment savings of more than 60%.

The replacement of oil circuit breakers with vacuum circuit breakers delivered several technical and operational benefits: elimination of risks associated with insulating oil, including leakage, fire and environmental contamination; reduced preventive and corrective maintenance requirements; improved mechanical and electrical endurance; enhanced switching performance and interruption capability; improved reclosing performance; lower auxiliary power consumption; greater operational reliability.

The modernization of protection systems through the installation of numerical relays further improved protection sensitivity, selectivity and operating speed. It also enabled: self-monitoring and internal diagnostics; disturbance and fault recording; event logging with time stamping; improved post-fault analysis; remote acquisition of protection data; integration into SCADA and substation automation systems; faster fault localization and restoration. The programme contributed to the broader improvement of continuity-of-supply indicators. Between 2007 and 2019, SAIDI decreased from 1,218 minutes to 139 minutes, while SAIFI decreased from 9.54 to 2.99 interruptions per customer. These improvements resulted from a combination of network investments, operational measures and organizational changes; however, the medium-voltage switchgear retrofit programme was one of the key technical measures contributing to increased substation reliability and reduced intervention time.

KEY SUCCESS FACTORS

A key success factor was the adoption of a condition-based retrofit strategy instead of full switchgear replacement. This allowed the company to retain technically serviceable assets, extend their useful life and allocate investment resources to the components with the highest operational risk. Another critical success factor was the integrated modernization of primary switching equipment and secondary protection and control systems. This ensured that the retrofit delivered not only improved switching performance, but also higher automation capability, better fault diagnostics and readiness for remote operation.

WAY FORWARD

Premier Energy Distribution has largely completed the medium-voltage switchgear retrofit programme at the facilities where the existing cubicle structures, busbar systems and primary connections were technically suitable for continued operation and adaptation to vacuum circuit-breaker technology. Accordingly, retrofit is no longer envisaged as a broad network-wide programme. Going forward, PED will apply this approach selectively, on a case-by-case basis, where the technical condition and configuration of the existing switchgear justify modernization without complete replacement. Where retrofit is not technically feasible or economically justified, PED will proceed with complete replacement of the respective switchgear equipment.

Before: Oil circuit breaker



After: Vacuum circuit breaker

