CASE STUDY

PNDC
UNIVERSITY of STRATHCLYDE

University of Strathclyde Glasgow

WHEN THE PNDC AT THE UNIVERSITY OF STRATHCLYDE NEEDED TO TEST POLE TO POLE FAULTS IN LVDC CABLES, THEY NEEDED A SOLUTION WHICH TRANSMITTED CONFIDENCE.

The project is focused on considering the conversion of existing Low Voltage Alternating Current (LVAC) infrastructure to Low Voltage Direct Current (LVDC). Projections of customer demand suggest that the loading on LVAC networks will increase as households transition to low carbon technologies.

Technologies such as Electric Vehicle (EV) charging and heat pumps will increase the domestic consumption of typical households. The switch to LVDC has power transfer benefits and may provide an alternative to conventional network reinforcements.

Historically most of the world's grids have run off almost entirely AC distribution networks. AC overhead lines are typically very resilient under fault conditions, as the power flowing in the network often redistributes itself very quickly without any need for external intervention.

However, DC short-circuit fault detection and ride through is a problem. The ability of aged cables to withstand realistic fault currents under typical LVDC conditions was of particular interest to the PNDC.

ETPS supplied the PNDC with two DC power systems, which were installed around a centre tapped earth. This allows the research group to recreate a bipolar DC arrangement in a lab, to replicate the intended LVDC test scenario.

Dr Edward Corr, Smart Grid Research Engineer for the PNDC, explained "The study investigated how aged LVAC cables withstood typical and extreme faults currents in an LVDC system. It's imperative that the cable assets could withstand these extreme conditions to ensure they are fit for purpose in LVDC applications."

"The bipolar DC system from ETPS allows us to accurately recreate specific fault conditions. This research will allow any LVDC cable considerations identified to be incorporated into future design and resilience planning."

> "THE BIPOLAR DC SYSTEM FROM ETPS ALLOWS US TO ACCURATELY RECREATE SPECIFIC FAULT CONDITIONS."

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SWITCHING TO DIRECT CURRENT

One test the ETPS DC power systems are used for is to charge two banks of capacitors. The capacitor bank aims to replicate the DC link capacitor in rapid EV (50kW) chargers. The banks apply fault currents of 8000A-16000A to the LVDC cable under test. The fault current is set by the resistance of the cabling between the capacitor bank and the sample under test.

A mechanical fault switch is used to apply faults between the two poles or pole to earth. The fault is applied by remotely operating the fault switch.

Post fault, the voltage across the capacitor bank is checked to confirm the fault was applied. The applied fault current magnitude is the primary area of interest for the PNDC. A simplified diagram of a pole to pole fault test is shown below. Pole to neutral faults are also investigated using the same DC systems.

Simon Hill, Delivery Programme Manager at the PNDC added "We highly value the comprehensive technical support and assistance which ETPS have provided us during this project."

"Being at the forefront of engineering research, it's crucial that we work with suppliers who match our ethos. The back and forth we've had with ETPS has been exemplary."

Based in Glasgow, the University of Strathclyde features the largest engineering department in Scotland. The PNDC was founded by the University of Strathclyde, Scottish Power Energy Networks and SSE Power Distribution, with support from Scottish Enterprise and the Scottish Funding Council.

It's a world-class R&D and demonstration venture, playing a key role in accelerating emerging low carbon technologies towards commercial deployment.

The centre provides this through a highly skilled post-doctorate team, alongside one of the world's most unique and comprehensive testing sites. The facility stays ahead of the curve by maintaining state-of-the-art assets, allowing real-world test environments to be created.

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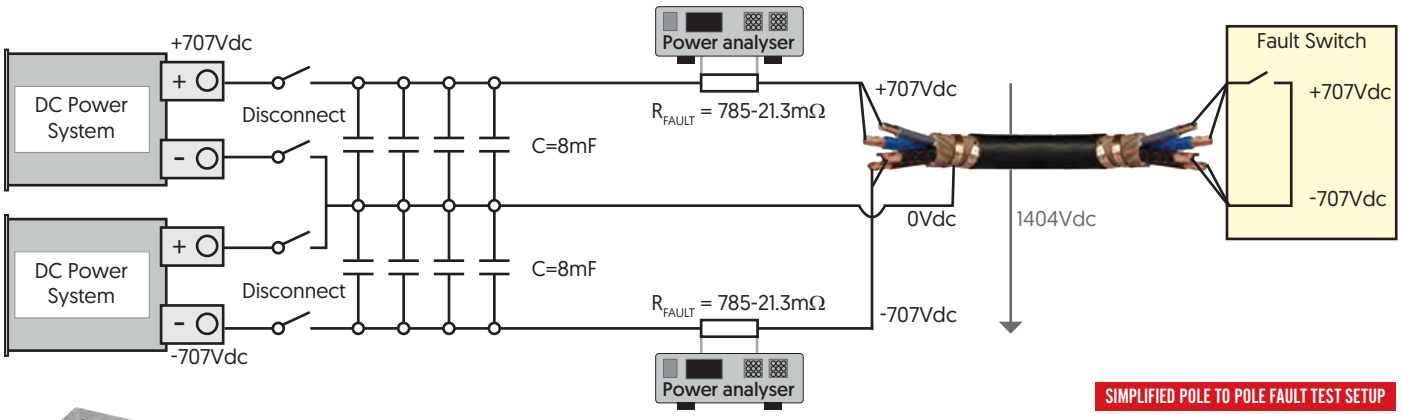

SIMPLIFIED POLE TO POLE FAULT TEST SETUP

ABOUT OUR DC POWER SYSTEMS

With one of the most comprehensive selections of DC power systems on the market, the ETPS team can engineer a product tailored exactly to your project.

Our systems can replace power feeding and consuming vehicle parts within a test set-up, so that individual components can be optimised.

A wide range of programmable current, voltage and power outputs are available for both sinks and sources. Both unidirectional and bidirectional systems up to 2MW are possible. Voltages up to 3000V can also be achieved via a centre tapped earth at high powers.

Specialised test equipment is available for many applications. This includes: battery emulation, photovoltaic simulation, battery cycling, electric drive testing, super capacitor simulation and fuel cell loading.

If your application requires something a little non-standard then we can look to provide a custom solution. Using one of our standard products as the base, electrical and mechanical modification can often be made.

If you'd like to discuss how an ETPS system could energise your test regime, contact us today.

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