HIGH VOLTAGE CURRENT INTERRUPTION WITHOUT SF6

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COST AND DURATION
The Carbon Trust contribution towards this project is £246,849. The project started in January 2005 and is due for completion in December 2007.

PROJECT REFERENCE NUMBER
2004-2-658

OBJECTIVES

The project aims to design, build and test full-size, high voltage prototype circuit breaker units that do not use sulphur hexafluoride (SF6) gas.

SF6 has a greenhouse gas potency 22,000 times greater than that of CO_2, with an upper atmosphere lifetime of 4000 years. Currently, there is no other technology that is available to replace these circuit breakers at these voltages.

SUMMARY

Electrical energy is transmitted more efficiently at high voltages. The transmission and distribution network is protected by circuit breakers. This is to prevent damage to generators, transformers, cables and end-user equipment from fault currents induced by equipment failure, lightning strikes etc.

These devices are designed to stop the fault current flowing by extinguishing a high temperature (>20,000°K) electric arc and then establishing sufficient dielectric strength to withstand voltage transients that arise on the electrical network when the fault current is interrupted. Thereby, the potential risk of damage is reduced.

SF6 is an excellent medium for extinguishing fault current arcs. After arc extinction, it provides excellent insulation properties to withstand induced voltage transients. These electrically stress the gas in less than one millionth of a second after the current has ceased to flow.

Exploratory work already undertaken on smaller experimental units at the University of Liverpool indicated that by generating suitable chemical species for interruption using nitrogen as the host gas, the units have comparable performance with units filled with SF6.

Experimental unit at the University's high current research facility. Source: University of Liverpool

The approach is to generate the appropriate chemical species from a solid that then recombine to form solid residues after the operation of the device. The species are required to enable successful current interruption and withstand voltage transients in the device over a wide range of currents and voltage conditions.

The project aims to produce and test a complete prototype circuit breaker that does not use SF6. This will be undertaken through developing the small-scale units to full size and optimising them to allow current interruption using nitrogen as the host gas.

The full-scale development will utilise advanced simulation packages to assist in the design and build of the prototype units, followed by tests using the University's high current research facility and voltage injection circuits.

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