Contribution ID: **272** Type: **Poster Presentation**

Proposing Supercritical Fluids as a Replacement for SF6 in High–Voltage Circuit Breakers

Wednesday 6 July 2016 14:30 (20 minutes)

Most modern equipment in power substations applies SF6 as the working gas for insulation and arc extinction.
SF6, sulphur hexafluoride, has powerful arc extinction properties and excellent insulation properties.
However, SF6 is a very strong greenhouse gas when leaked and it leaves extremely toxic oxides after operational lifetime in circuit breakers.
Researchers and companies are gradually turning their focus towards finding SF6-free solutions for circuit breakers.
Countries like Australia, Sweden and New Zealand, are already pushing users in a non-SF6 direction.
Well-known options for replacement are: vacuum, CO2, and oil, but these have their typical drawbacks which vary from insufficient current/voltage rating to deterioration of the medium itself. We have been proposing supercritical fluids as an alternative already since 2009 [1]. Dedicated research started in 2011 [2,3]. We will present a short review of research on switching plasmas in supercritical fluids, highlighting advantages such as inertness, extreme breakdown strength and fast recovery.

[1] van Heesch, E.J.M. ,Pemen, A.J.M. , Liu, Z. , Beckers, F.J.M. , Voeten, S.J. , van Bree, J.W.M. , Ariaans, T.H.P. , Winands, G.J.J., Applications of repetitive pulsed power, research at TU/E, IEEE International Conference on Plasma Science - Abstracts, ICOPS 2009.

[2] Zhang, Jin, EJM van Heesch and A. J. M. Pemen. "Breakdown Voltage Estimation of a Supercritical Nitrogen Plasma Switch" Proceedings EAPPC2012, 2012.

[3] Zhang, Jin, et al, Breakdown Strength and Dielectric Recovery in a High Pressure Supercritical Nitrogen Switch, IEEE Trans. on Dielectrics and Electrical Insulation, Vol. 22, No. 4, 2015.

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Session Classification: Poster 1-B

Track Classification: Dielectrics, Insulation, and Breakdown