Abstract Submitted
for the GEC16 Meeting of
The American Physical Society

Two color interferometric electron density measurement in an axially blown arc PATRICK STOLLER, JAN CARSTENSEN, BERNARDO GALLETTI, CHARLES DOIRON, ALEXEY SOKOLOV, REN SALZMANN, SANDOR SIMON, PHILIPP JABS, ABB Switzerland Ltd. — High voltage circuit breakers protect the power grid by interrupting the current in case of a short circuit. To do so an arc is ignited between two contacts as they separate; transonic gas flow is used to cool and ultimately extinguish the arc at a current-zero crossing of the alternating current. A detailed understanding of the arc interruption process is needed to improve circuit breaker design. The conductivity of the partially ionized gas remaining after the current-zero crossing, a key parameter in determining whether the arc will be interrupted or not, is a function of the electron density. The electron density, in turn, is a function of the detailed dynamics of the arc cooling process, which does not necessarily occur under local thermodynamic equilibrium (LTE) conditions. In this work, we measure the spatially resolved line-integrated index of refraction in a near-current-zero arc stabilized in an axial flow of synthetic air with two nanosecond pulsed lasers at wavelengths of 532 nm and 671 nm. Generating a stable, cylindrically symmetric arc enables us to determine the three-dimensional index of refraction distribution using Abel inversion. Due to the wavelength dependence of the component of the index of refraction related to the free electrons, the information at two different wavelengths can be used to determine the electron density. This information allows us to determine how important it is to take into account non-equilibrium effects for accurate modeling of the physics of decaying arcs.

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Date submitted: 14 Apr 2016 Electronic form version 1.4