# MEASUREMENTS AT CURRENT ZERO IN A SF6 GAS BLAST BREAKER

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## INTRODUCTION

Post arc current measurements are important for checking the range of validity of arc models which quantitatively predict the post arc currents in h.v. breakers according to the residual conductivity |e.g. 1|. In the case of $SF_6$ axially blown arcs however, such measurements place high demands on the measuring equipment because of the rapid recovery that takes place. To date only few measurements in this regime have been reported, and those were obtained under various conditions |2,3,4|. It has even been stated that $SF_6$ post arc currents cannot be detected. In the following report a measuring method is described which detects currents far below 1 A |5|. Tests are carried out with this measuring system (response time $\tau_r$ < 35 ns) on a metal vapour-free axially blown $SF_6$ arc.

## EXPERIMENTAL SETUP

The nozzle arrangement selected (Fig. 2) permits unrestricted optical observations except for the narrow orifice region (high speed-,schlieren photography). The vapour produced by the upstream electrode is drawn off through a small orifice in the electrode. A square-wave current pulse (1.5 kA, 5 ms) followed by a decay rate of 30 A/µs is generated by an LC network |6|. The arc forms a stable plasma column up-stream, while it is greatly influenced by turbulence downstream (Fig. 3).

The recovery voltage is supplied by a h.v. LC network (Fig.1). The spark gap F is fired approx. 25 µs before the end of the 1.5 kA pulse (current injection, Fig.5,7).

The RRRV is determined by resistor $R_2$. The post arc current is determined from the voltage drop across the 10 Ω shunt $R_S$, which is short circuited by the fast diode D before current zero.

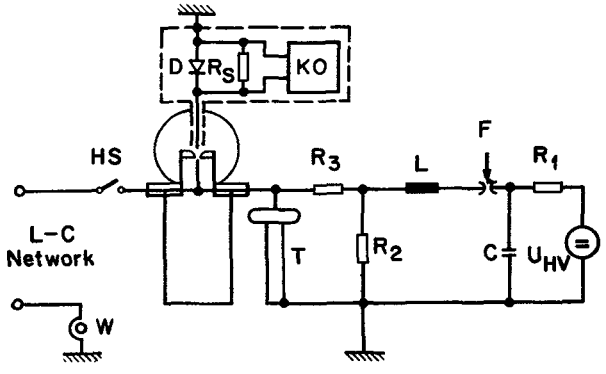


Fig. 1: HS: vacuum breaker
W : current transformer
T : resistor/capacitor divider ($\tau_r$ < 5 ns)
KO: battery-powered oscilloscope

In this measuring arrangement strict coaxial design of all components must be preserved. Also the diode D consists of many coaxilly arranged diodes. In addition, the diode characteristics should include a high maximum peak forward surge current, high reverse voltage in case of a restrike of the test section, low reverse currents, low junction capacitance and a short recovery time. Since it is not possible to obtain all these requirements simultaneously, the most favourable compromise must be sought for each measuring task. The response time $\tau_r$ of the post arc current measuring device is less than 35 ns.

## RESULTS AND DISCUSSION

The measuring setup enabled precise post arc current investigations to be performed.

A great number of tests showed that in the case of interruption measurable post arc currents (Fig.6) occur only under conditions lying at the limit between extinction and thermal reignition. Fig. 4 shows a post arc current measurement during reignition near the critical condition. The post arc currents measured agree im amplitude and temporal evolution with theoretical values |1|, although in the experiment the current decay rate is seen not to have a single constant value (Fig.5,7). To a great extent the voltage rise (0.27 kV/µs) at the current zero is linear. The extinction limit measured agrees with the theoretical values |1|, when an average current decay rate (20 A/µs) is assumed. The limited observation of post arc currents leads us to believe that insulating layers are encountered which must be broken down, and that this is only possible in the vicinity of the extinction limit and often leads to reignition. Investigations with other networks confirm this assumption, but this phenomenon should not affect the extinction limit.


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|2| Frind G., IEEE Conference Paper No. F 79 288-2 (1979)
|3| Kobayashi A., et al. IEEE PAS-97 1304-1312 (1978)
|4| Murano M., et al. IEEE PAS-94 1890-1900 (1975)
|5| Moll R., Schade E., ISH, Milan 1979
|6| Hermann W., et al. IEEE PAS-95 1165-1176 (1976)


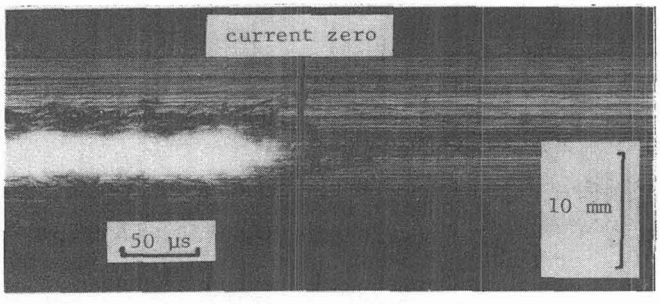


Fig. 3 Schlieren record

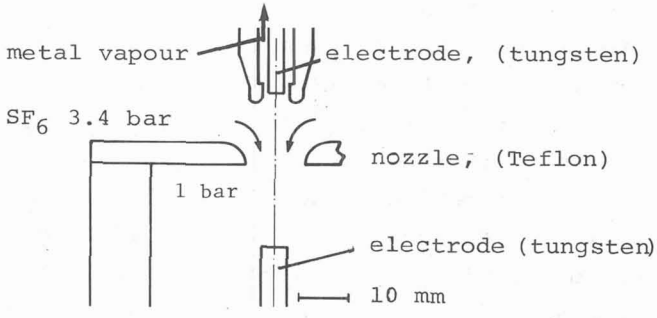


Fig. 2 Test breaker

Reignition

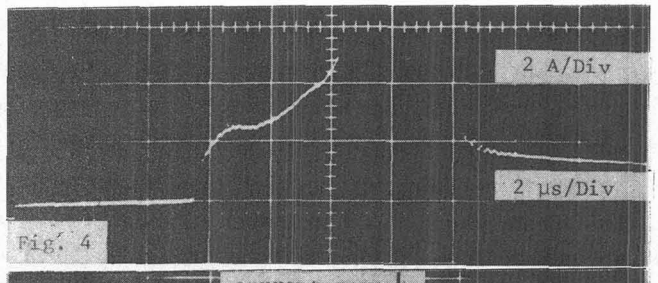


Fig. 4

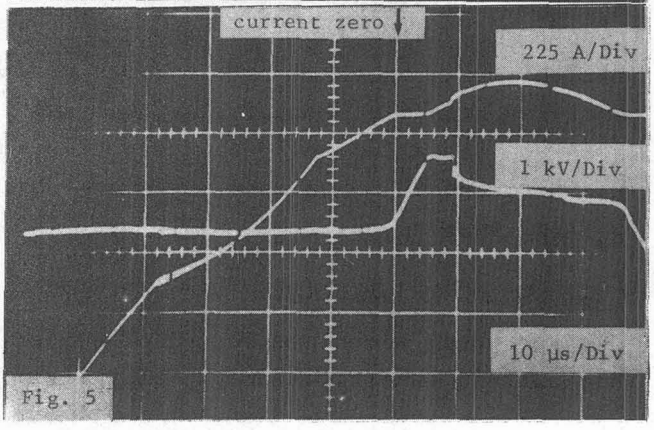


Fig. 5

Interruption

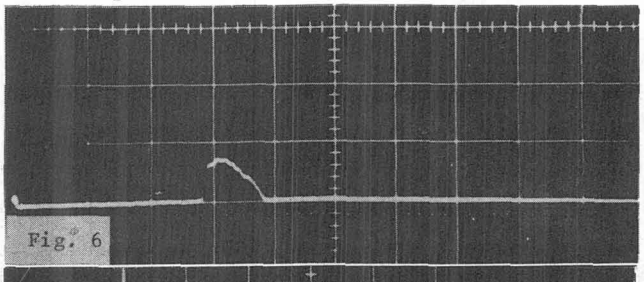

Fig. 6

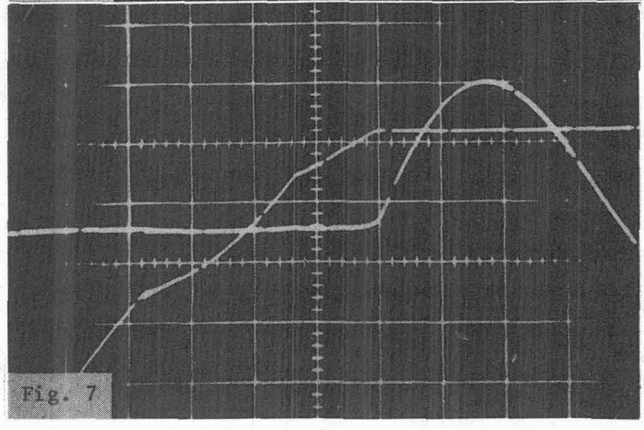

Fig. 7