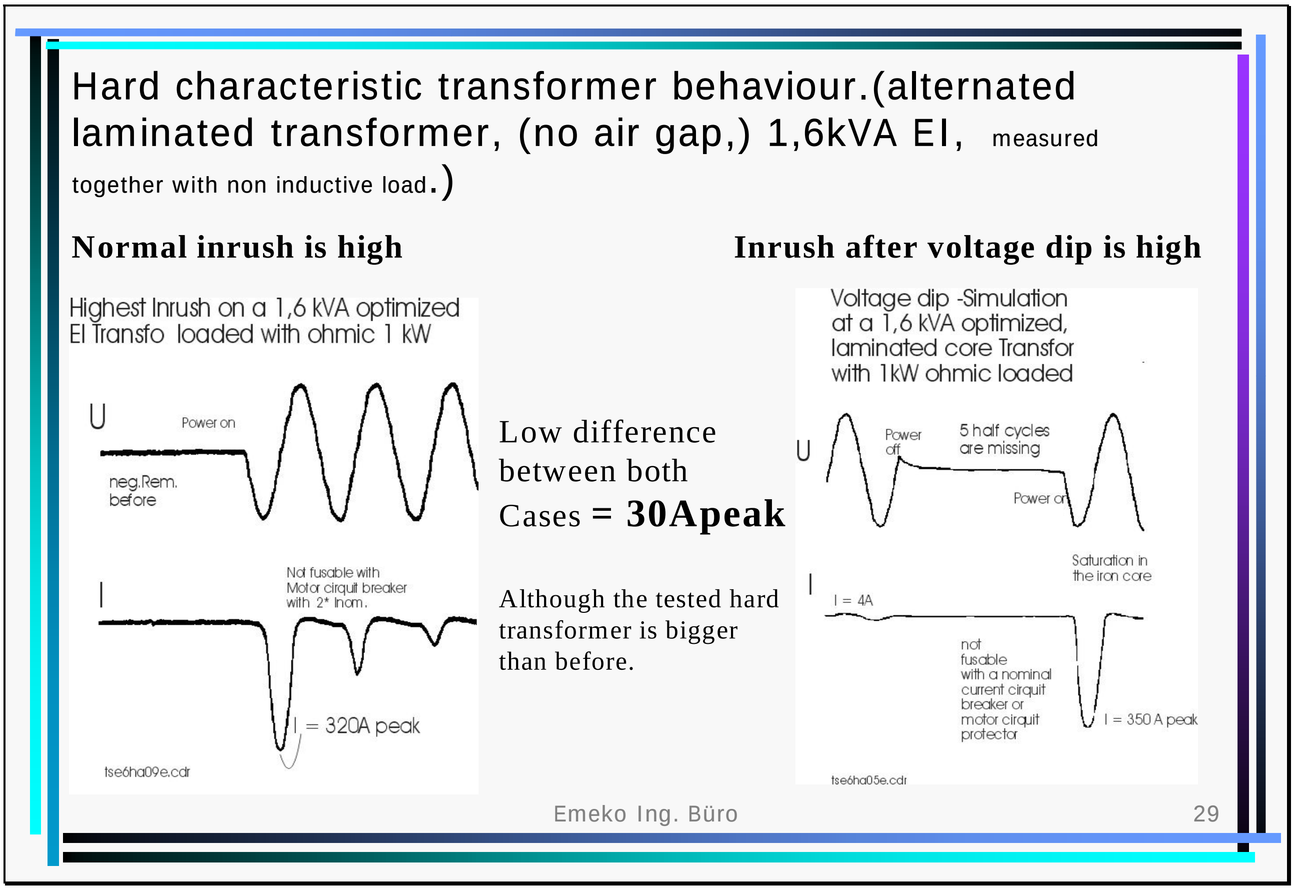
Line voltage defects, like so called „Voltage Dips“, can trip the fuses mounted in front of transformers!

Some Electrical and Electronically Equipment must be tested with a voltage dip of 10 msec. correspond EN 61000-4-11.
IEC 61000-4-11 is Included in the IEC 60601-1-2.
Medical Equipment must withstand this test, without any failure.

Following graphs are showing the consequences of voltage dips on transformers. They are measured with, and without a transformer switching relay, TSRL. A transformer switching relay- TSRL, avoids Inrush current peaks on transformers.: Picture 5 is showing a TSRL.

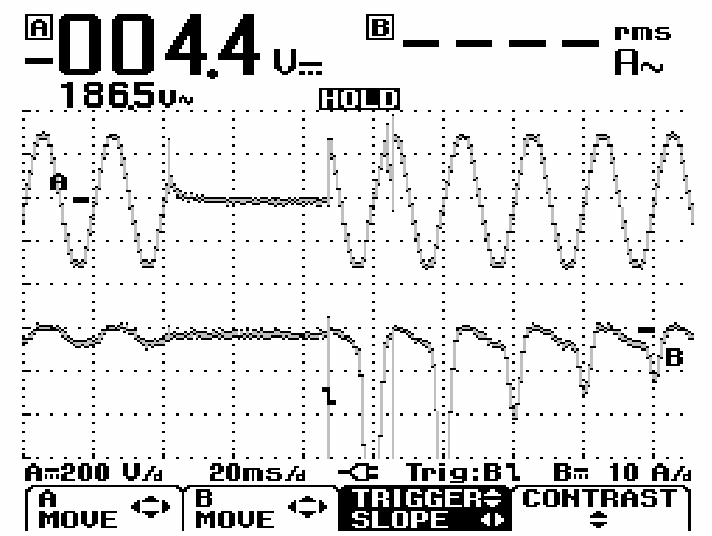
Graph 1, is measured without a TSRL in front of the transformer .



Graph 1 shows the biggest inrush of a transformer, when a unpair quantity of half waves was missing. Inrush is bigger than with normal switch on in the worst case, after a long time pause,
While in the short time of this voltage dip the magnetisation can not run back to his stable remnance point in this short pause of 10 msc..
Therefore the core saturation is higher than with normally switch on in the worst case.

This occurs in a serious manner, when a 0,5 period voltage sag occurs on a transformer, when he is tested correspond:EN 61000-4-11, chapt. 4. 3 voltage dip : (definition used for the purpose of this standard). For a single phase voltage of period T, there is a voltage dip if the rms value calculated with a time window (duration multiple of T/2) is lower than 90 percent of the declared voltage. It starts at the beginning of the first window and ends at the end of the last window which verifies the previous condition.
The worst case for an inrush is when missing one half wave, a 0,5 period.

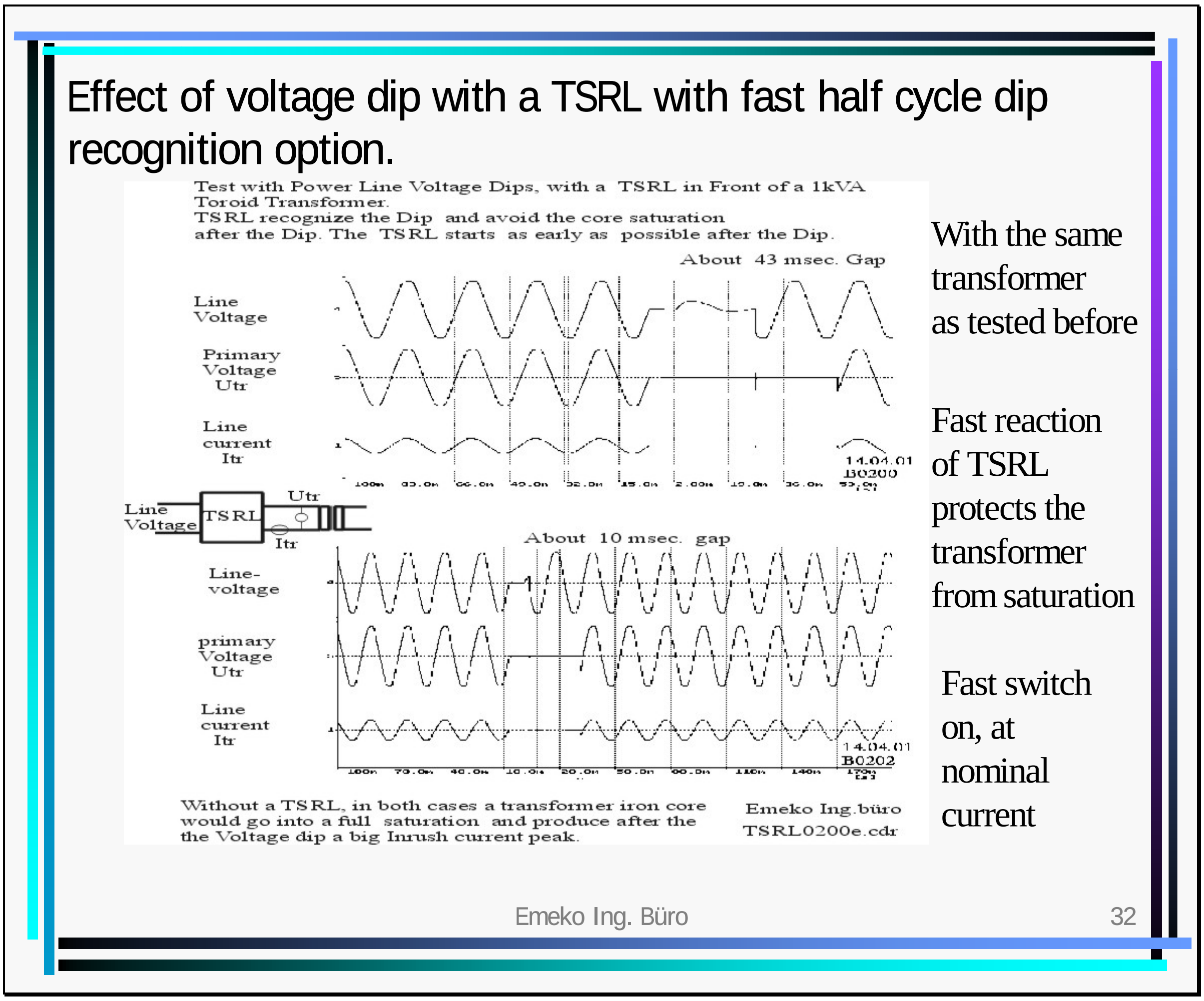
Graph 2, is measured without a TSRL in front of the transformer . The missing half waves are produced by a loose connection.



shwat001.fvf, schneller Halbwellenausfalltest, gemessen v. EMEKO Ing. Büro. an 0,8kVA EI Trafo mit Ohmscher Last, indem Netzsteckerwackler erzeugt wurde.A = U an Trafo prim, B= I in Trafo prim. getriggert auf I peak

Sometimes fuses are tripping accidently, without any reason.
Line Voltage asymmetries could be the reason.
This over current peaks can be avoided with a TSRL with the option “fast recognition on voltage dips”, in front of the transformer.

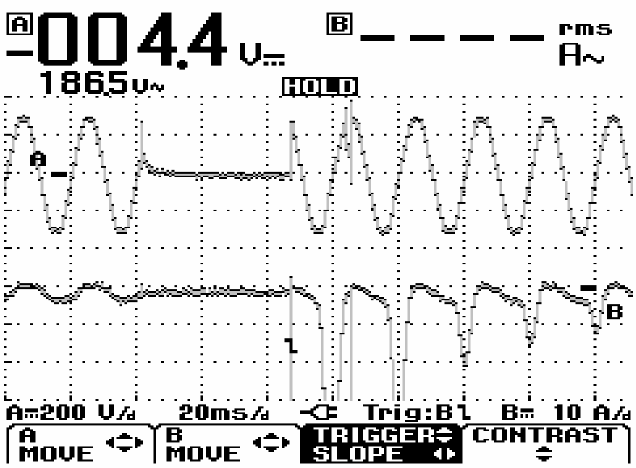
Graph 3, measured with a TSRL in front of transformer



The effect of inrush after short time line voltage dips, can be avoided with a TSRL with the option: -----
„ schnelle Halbwellenausfall Erkennung.“= fast reacting on voltage dips. Fast switch off after a dip and a calculated fast switch on at the right time after voltage coming back.

The duration of the voltage gap at the transformer, after the TSRL, will be about 20 msec. longer than the power line gap, because the TSRL must wait on the right switch on point. He calculates it.

Graph 4, Measuring curves on a transformer, while feed with voltage dips, per accident, by pulling and shaking the power line connector . No TSRL was connected in front of the transformer under test.



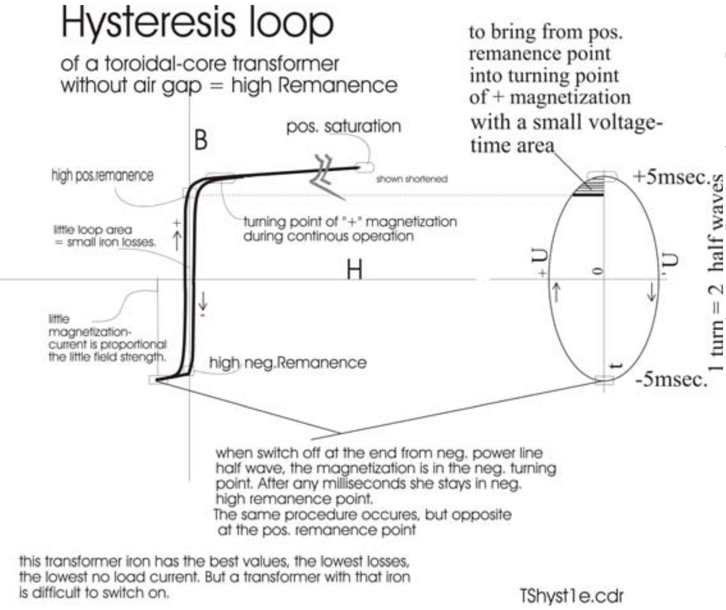
shwat001.fvf, schneller Halbwellenau sfalltest, gemessen v. EMEKO Ing. Bü ro. an 0,8kVA EI Trafo mit Ohmscher Last, indem Netzsteckerwackler erzeu gt wurde.A = U an Trafo prim, B= I i n Trafo prim. getriggert auf I peak

In Graph 4 is showed the Demonstration of the effect on transformers when a voltage dip occur per accident in the worst case.
Here the transformer gets two times after the other the same polarity of a voltage time area, before and after the dip. He goes full into saturation and draws a big inrush current peak.-

Transformers in medical equipments, must be tested correspond EN 61000-4-11, with voltage dips of 0,5 cycles. See Image 10 and 12. Then two similar half waves with the same polarity from the power line voltage brings the core into full saturation. The fuse in front of the transformer trips and in some medical applications the test fails. A TSRL can avoid this.

For that reason, more and more manufacturers of medical equipments are getting the TSRL and can pass the Test with voltage dips correspond EN 61000-4-11.

Bild 4.



The induction in the remnance point is nearly so high like the induction at the turning points of the hysteresic loop, reached at every end of each half wave. The magnetisation in the remnance point stays on the same point as long, until the transformer is switched on again. Remnance means residual magnetism.

Toroidal Transformers, see curve in picture 4, have no air gaps and have another hysteresic curve, than EI –core Transformers. The hysteresic loop is straight vertical oriented and have a very small hysteresic loop. The no load losses are 100 times smaller than with an EI core transformer. The losses are represented by the area inside the hysteresic loop.

Up to now, all ordinary inrush current limiters has the disadvantage, cannot deal with voltage dips.
The TSRL can.
www.noinrush.com

Bild 5. 4kVA Trenntrafo mit TSRL