

MEETING THE EUROPEAN UNION DIRECTIVE LIMITS ON INDUCED CURRENTS AND CONTACT CURRENTS IN HIGH VOLTAGE SWITCH YARDS

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The European directive 2004/40/EC on minimum health and safety requirements regarding the exposure of workers to risks from electromagnetic fields, will be mandatory in the member states in 2008. Most European member states already have some regulations for radiofrequency field but usually not for low frequency fields. I therefore focus on the demands on low frequency electric and magnetic fields. Exposure to time varying electric and magnetic fields result in induction of internal body current, and the known adverse effects are associated with nerve excitation. ICNIRP's basic restriction therefore limits the induced current density in CNS. In the frequency range 4 Hz – 1 kHz, the limit is set at 10 mA/m² (rms, averaged over a cross-section of 1 cm² perpendicular to the current direction) for occupational exposure, a value not to be exceeded at any time, according to the directive. From this basic restriction, reference levels have been calculated assuming a worst case scenario.

One example of a work environment where there will be some problems to fulfil the directive is in high voltage switch yards. At 50 Hz the directive's action value (which equals ICNIRP's reference levels) for electric field is 10 kV/m and the action value for magnetic field is 500 μ T. Our measurements in Swedish 400 kV switch yards have shown that the electric field strength quite commonly exceed the action value, while the magnetic field usually is within the action value. Simulations, similar to the one described in Hamnerius 2006, of the induced current in the central nervous system for a man standing in a 50 Hz electric field indicates that field strengths up to about 25 kV/m can applied before the limit of 10 mA/m² is reached.

The directive is based on ICNIRP's guidelines from 1998, which also takes the contact currents when touching objects in account. ICNIRP's guidelines give the opportunity to increase the action value to 20 kV/m when adverse indirect effects from contact with charged conductors can be excluded. This is however not mentioned in the directive. The action value for contact current is set to maximum 1 mA in the directive. We have measured the contact current for different work tasks, in 400 kV switch yards, to see for which situations the action value is fulfilled (Cedergren 2006, Hamnerius and Cedergren 2007).

The work in switch yards involves touching of control units of circuit breakers and disconnecting switches as well as other grounded metallic objects exposed to electrical fields. For stationary body to ground contact current, i.e. when contact has been established, the current was measured using a sensitive ampere meter. Pre contact spark discharge currents were measured with a current probe connected to a digital oscilloscope.

An example of measured stationary contact current, when touching breaker units is shown in Figure 1. The highest current value when a person touches a single grounded object was 180 μ A. A worse case is when a person simultaneously touches an ungrounded object exposed to the electric field and a grounded object at the same time. A contact current of 1.17 mA was measured when a person simultaneously touched a vehicle and a grounded pole. Spark discharges at pre contact with a grounded object was found to cause the most annoyance by their stimulation of muscle nerves, but such discharges are not limited in the regulations. Levels of up to 1.75 A during a fraction of a second where obtained.

The conclusion is that the stationary contact currents are below the action value if simultaneous touching of grounded and ungrounded objects in the field is avoided. Thus the

action value for electric field can be raised to 20 kV/m, a field strength that usually is not exceeded in 400 kV switch yards.

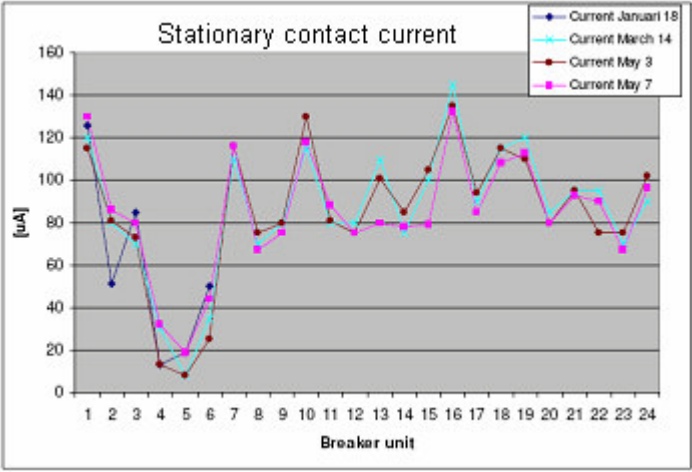


Figure 1. Stationary contact current