ELECTROMAGNETIC THREATS TO THE CIVIL INFRASTRUCTURE (Invited)

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ABSTRACT

There are two possible ways that intentional electromagnetic interference (IEMI) could be produced in the civil infrastructure: irradiating by electromagnetic field and injecting by electric pulses. Results of testing objects of the civil infrastructure to the influence of ultrawideband (UWB) electromagnetic pulses and high voltage pulses are presented in the paper.

The following technical means have been developed to estimate the immunity of infrastructure objects to intentional electromagnetic disturbances:

- Sources of UWB electromagnetic field pulses;
- High voltage pulse generators.

Typical automatic access control systems, electronic cash machines, electric energy consumption meters, computer systems, etc. have all been tested to determine the influence of UWB electromagnetic pulses. Tests have shown that a UWB pulsed electric field with peak value above 2 kV/m may cause permanent failure of the function of equipment. Restoring serviceability of some tested objects required a period of time from several minutes up to several hours. At higher amplitudes (above 5 kV/m) physical damage of equipment elements took place.

An office building, an automatic telephone station, two stations of cellular communication, a telecommunication center, an electric substation and a power line have been tested for the influence of high voltage pulses. During these tests it was found that in many cases equipment malfunctions occurred at very low levels of disturbance. For example, interruption of communications occurred as a result of the injection of 0.5 volts into power circuits of the technological instrumentation of an automatic telephone station. It is possible to damage computers located inside a building by injecting 10–20 kV voltage pulses with each with an energy content of about 1 kJ. Power line insulators have been tested for the simultaneous action of a high-voltage pulse disturbance and the operating voltage of a line. Investigation of the physical laws of insulator flashover due to fast voltage pulses with power on has shown the following:

- Flashovers of insulators have occurred;
- Electric characteristics of insulators degrade after flashovers;
- Repeated flashovers cause a decrease of the breakdown voltage and further degradation of the operational parameters of the insulators. Destruction of insulators may be a consequence of such effects.

The performed experiments indicate that there is a serious danger from electromagnetic terrorism, and there is a necessity to develop preventative measures. To check the efficiency of various means of protection, a special experimental model of a typical object of the civil infrastructure has been developed. This model consists of an actual three-phase power network, a typical automatic access control system, an electric energy consumption meter, a local computer network, a fire signal system, etc. Experiments have shown that this model is a convenient means for training personnel for actions to eliminate the consequences of acts of electromagnetic terrorism.