



## Protection of Power Substations Equipment Against Electromagnetic Pulse

Using digital protective relays (DPR) and power transformers as an example, the book discusses practical aspects of protection of power substations equipment from devastating impact of High Altitude Electromagnetic Pulse and other types of Destructive Electromagnetic Interferences generated by equipment that has been intensively developed and improved over the last years.

Different technical solutions and organizational measures aimed at improvement of power substation survivability are offered.

The book is intended for specialists operating electric equipment at power substations, designers, manufacturers of DPR and industry managers. It will also be useful for teachers, post graduate students and students of Higher Educational establishments majoring in the field of electric energy industry.

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Some 20-30 years ago the concept of High-Altitude Electromagnetic Pulse (HEMP) was only mentioned in the brochures on civil defense. Moreover, it was just quickly touched upon and that was it. That's why electromagnetic pulse is now perceived as something exotic and obscure. Military men were well informed about this effect of nuclear explosion; however information on this topic was strictly confidential. It was pretty sound at that time, considering technical obstructions and expenses related to obtaining of this information. However, this resulted in the fact that until recently civil specialists working in different fields of engineering science had no idea (and some of them are not aware even now) about this phenomenon and the danger that it may pose.

Meanwhile, modern trends of engineering development, resulting in wide-spread use of microelectronics, microprocessors, PCs, quick improvement of microprocessors' capacity accompanied by sharp increase of microtransistors count per a unit of volume, reduction of operation voltage and insulation level between internal elements and the layers in a crystal, lead to sharp increase of susceptibility of modern equipment to HEMP and stimulated interest of army men to use HEMP as a self-sufficient and very efficient type of weapon. Some time ago this affecting factor of was interesting for army men as a reliable way of destruction of air-plane's electronic systems and missiles by means of anti-aircraft and anti-ballistic missile system (war-heads of many missiles of such systems (even those of short range) were equipped with nuclear weapon), whereas now it becomes clear that HEMP is an ideal non-lethal weapon capable to destroy the infrastructure of the enemy almost completely without hecatomb, if a nuclear weapon is exploded at high altitude. This has inspired the military men so much that they ordered development of a special nuclear charge with improved effect of electromagnetic pulse – a so called "super-EMP". Simultaneously, development of purely electromagnetic weapon was underway, where powerful electromagnetic emission affecting modern microelectronic and microprocessor-based systems is generated by non-nuclear source. Electromagnetic bombs, shells, grenades and missiles with electromagnetic war-heads, mobile units on wheel or track chassis that generate powerful directed electromagnetic radiation capable to destroy electronic equipment from large distances are not science fiction anymore, but contemporary realities. Unfortunately, it should be noted that these realities are still not broadly addressed by specialists of many field of engineering science, particularly those in the field of electric energy industry. Indeed, electric energy is the foundation of a country's infrastructure, without which neither water supply system nor communication or any other vital system can operate.

In a series of previous articles and books I tried to attract attention of the specialists to the actuality of this problem due to increasing danger of destruction of electric energy system with these types of weapon.

***This book emphasizes practical recommendations on protection of power substations' electric equipment from Intentional Destructive Electromagnetic Interferences, including HEMP.***

It should be stressed that protection of power substations' electric equipment (and other facilities of electric energy industry) from these impacts is a multilateral problem, which should not be solved by power engineers only. The industry that is producing microelectronic and microprocessor-based equipment for energy industry should also be involved. That's why recommendations provided in the book are intended for not only staff operating electric equipment, but also for manufacturers of this equipment, particularly digital protective relays; specialists of designing companies, managers of electric energy industry as well as for teachers, post graduate students and students of Higher Educational establishments.