

**Study Committee C3 "System
environmental performance"
PS 1 "Effectiveness and environmental prevention,
mitigation and compensation measures"**

**Ecological and Occupational Electromagnetic Safety of Power Grid Facilities
Improvement**

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Power transmission electromagnetic safety maintaining two main directions includes: power frequency electric and magnetic field (EF and MF) potential negative effects on workers as well as reducing its impact on the population. Along with protection by time (realized in the Russian Federation hygienic regulations, but not applicable in most another countries standards) and protection by distance (due to right-of-way zones along transmission lines) the most appropriate approach to occupational and environmental electromagnetic safety is EF and MF exposure reduction by engineering solutions applying.

Power frequency (PF) EF and MF hygienic standard values assurance as in the places of population residence and in the workplaces, is not always possible. PF EF exposure workers protection in extremely high voltage outdoor switchgears is achieved by using designs that reduce EF levels by using the compensating action of current-carrying parts opposite phases, high equipment racks shielding effect, the performance of buses with the minimum number of splitted wires in phase with the minimum possible sag as well as other measures.

Optimal ways of PF EF and MF ecological effects decrease as well as some cases staff exposure effects are new (patented in Russia) technical solutions, including:

- The Antenna method of extremely high voltage (EHV) overhead transmission line corona discharge electromagnetic field decrease;
- Compact double-circuit coaxial and single-radius transmission lines PF EF and MF, effected on people and environment full compensation;
- Shielding of EHV overhead transmission line electric fields by means of passive, active and resonant cable screens;
- Shielding of EHV overhead transmission line magnetic fields by means of passive, active and resonant directed contour screens;
- Electromagnetic screens for electric reactors without the ferromagnetic core magnetic field intensity decrease;

- Designs of electrical reactors without the ferromagnetic core with the lowered levels of magnetic field in near zone.

Long experience of electrical substations, overhead and cable lines service and maintenance shows that the most effective way of staff protection from EF impact is the use of personal protective equipment (conductive suit), as other methods of personnel protection complicate (restrict) the work on operating equipment. Conductive suit (CS) main characteristic that determines protective mean properties is CS shielding factor which should reduce the level of EF exposure to safety value in work time.

CS shielding efficiency is determined by testing. The greatest difficulty lies in the evaluation of CS shielding effectiveness. This is due to the fact that the existing hygienic standards – maximum permissible levels, consider the physical characteristic of the field (the RMS EF strength). In the present regulation the screening efficiency is considered as indirect characteristic of external field, i.e. the so-called induced currents in metallic phantom, dressed in CS and placed in non-uniform field, simulating a power line at different voltages.

The lack of maximum permissible levels and CS shielding efficiency comparison by means of induced currents, the uncertainty in the laboratory test conditions to PF EF in the location of the test sample, as well as incomplete consideration of human's exposure worst conditions, taking into account protective mean structural features require improved test methods. It is very important for staff safety in power grid facilities.

Scientific and practical substantiation of shielding assessment general methods as one of the stages of human security principles improvement, allows to ensure protective mean efficiency, and to provide of personnel safety assessment methods international harmonization. Developed requirements and methodologies for CS effectiveness assessment based on international experience, allow us to determine the extent of its use to ensure PF EF adverse effects workers protection and develop recommendations for individual protective mean design further improvement.