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EMC and radiation hazards

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THE ELECTROMAGNETIC interference (EMI) control engineer has the assignment of directing other engineers in reducing and containing the equipment's spurious electromagnetic energy generation and susceptibility characteristics. In addition, he subjects the designed equipment to tests in accordance with EMI specifications to validate the design control criteria.

During these phases, the EMI engineer pays little attention to the effect of electromagnetic energy on living matter. Though automated equipment requires minimal operator control, man still functions in the vicinity of this equipment. Thus, the equipment alters the electromagnetic field environment that is normally being provided by nature.

The total effects on man by the electromagnetic environment have not been fully documented. However, increasing amounts of data collected by other disciplines are appearing, primarily in medical and biological journals. In a recent report on man's use of the electromagnetic spectrum titled "Spectrum Engineering — the Key to Progress," there is a section which considers the side effects of electromagnetic energy. A paper by Rexford Daniels is based on this report; it is titled "Nature, the Interface in Electronics" and was given at the 1968 IEEE International Convention in New York.

Thus, the EMI control engineer, in assessing the electromagnetic environment to which the electronic equipment will be subjected, must also consider the effect of the electromagnetic environment on the operating personnel.

The new generation of EMI specifications requires tests which subject equipment to electromagnetic radiation fields of up to 20 V/m field intensity. Performance of this type of test within a shielded area will subject the test personnel to these fields. If the standing wave conditions within the shielded area are not effectively controlled during this type of test, electromagnetic energy may have adverse effects on the test personnel.

Radiation and EMC

With the present emphasis on safety, it is necessary for the EMI control engineer to become familiar with the increasing knowledge about RF effects on humans and other living matter. With the wider use of the frequency spectrum and the higher radiating powers of communication and radar transmitters, the EMI control engineer will be required to add control of radiation hazards to his normal activities.

The electromagnetic compatibility (EMC) engineers do not consider the compatibility of man with the electromagnetic environment. The new electromagnetic interference control specifications, such as MIL-STD-461 and other special program-oriented EMI specifications, require that equipment be exposed to field intensities of as high as 20 V/m. This figure includes the 6 dB safety margin as required by most system-level EMI specifications. However, how often do EMI control engineers analyze and verify the electromagnetic environment in light of the human's susceptibility to electromagnetic radiation fields?

We can provide the necessary shielding materials and the appropriate interference reduction networks required to protect equipment from extremely high field intensity levels. These may reach 50 kW for communications transmitters, and 25 MW peak power for radar transmitters. However, some military specifications contain a radiation hazard warning stipulating a limit of 10 mW/cm² to limit personnel hazard.

Despite these warnings, I have not observed RF field intensity monitoring devices—or even warning signs—being used where personnel are engaged in adjusting high-power transmitters, or performing radiation susceptibility tests. Neither have I seen them in areas where powerful transmitters are providing communication services. Such monitors or signs should be provided to warn of possible hazards from RF radiation.

The lack of sufficient attention to human radiation effects by the EMI control engineer can possibly be explained by a lack of understanding. This is due to the relatively few documents available on the subject. In part, this may be due to the length of time required to observe the more subtle effects of RF radiation. For example, if laboratory animals are used to obtain data on radiation effects, their growth during the tests will alter their frequency of resonance. The length of time allowed for exposure to discrete frequencies and the observation of the resulting radiation effects is, at present, very limited. Thus, the observed effects of electromagnetic radiation on animals as a corollary to the effects on humans are somewhat minimal.

The Air Force Aerospace Medical Research Laboratories released a bibliographical listing several years ago containing 129 references of responses to RF radiation for animals and humans. The majority of papers referenced in this document dealt only with responses of living matter to the microwave region of the spectrum. Yet, the EMI control engineer has to be concerned with the responses of electronic and electrical equipment throughout the RF spectrum extending from dc to 5 Fermi or 10^{23} Hertz. Discrete magnetic and electric field energy in the Vorticity Zone, and plane waves in the Fraunhofer Zone also need to be considered.

Though research is continuing in medical laboratories and universities on radiation effects, the dissemination of the increasing knowledge is limited primarily to medical journals. The IEEE Group on Electromagnetic Compatibility has published only a few