

Investigating R&D Committee on Trends in Basic Technologies for Advanced Dosimetries of Electromagnetic Exposure

Electromagnetic Environment Technology Committee

1. Objective

Protection guidelines for the safety of human body from electromagnetic field exposure provide guideline values, which are induced physical quantities in biological tissues such as induced electric fields at low frequencies and absorbed power at high frequencies, by considering the safety factors for these threshold values of biological effects. For this reason, it has become an important technical issue in recent years to assess the relationship between electromagnetic field exposure and the induced physical quantities in the body in tandem with realistic electromagnetic field measurements and computer simulations. Ascertaining the latest trends in advanced electromagnetic field measurement and electromagnetic field analysis technology to solve those technical problems has become a necessary research target.

In recent times, in the energy field, contactless wireless power transmission systems for various applications have been proposed in a wide frequency range from the intermediate frequency bands to the millimeter wave bands. In addition, in the information communication field, next-generation radio communication technologies represented by the fifth-generation radio communication system (5G) and even more advanced systems—beyond 5G—are widely spreading. These are innovative technologies based on the concept of Society 5.0, and it is desirable that the characteristics of the electromagnetic environments assumed for such advanced radio systems be understood and an appropriate basic technology for exposure assessment be developed. In addition, the standardization of such basic technology for exposure assessment is important.

Against this background, this investigation committee shall focus on ascertaining changing electromagnetic environments due to rapidly developing energy and wireless systems and on advanced measurement assessment, computer simulation, and ICT technology that can respond to such changes. Thereby, this committee shall investigate the latest trends in utilizing such techniques for human body protection. In addition, it will investigate the conformity of these basic technologies for advanced exposure assessment while standardizing human body protection guidelines and exposure assessment techniques. These investigations are aimed at contributing to greater knowledge in the field.

A separate investigation team of the Electromagnetic Environment Technology Committee will investigate the biological effects of electromagnetic fields as a related topic, focusing on electromagnetic field health risks, and shall thus be involved in such activities.

2. Background and internal and external research activities

Efforts by the IEEJ to address problems in assessing the induced physical quantities in the body due to electromagnetic field exposure through numerical electromagnetic field analysis or measurement began with the inauguration of the "Special Committee to Investigate the Problem of the Biological Effects of Electromagnetic Fields" in 1995. Thereafter, five investigation committees have been set up following the "Investigation Committee for Induced Electric Fields and Current in the Body by Electromagnetic Fields" established by the Electromagnetic Environment Technology Committee. These have continuously investigated the latest numerical calculation techniques and numerical human models for the estimation of induced physical quantities and measurement techniques for electromagnetic fields in frequencies ranging from the low and intermediate frequency bands to high

frequency bands; moreover, they have identified application methods and issues for numerical calculation technology in assessing conformity with human body protection guidelines. In the meantime, research on living bodies and magnetism mainly due to direct current to the intermediate frequency bands is being carried out by multiple investigation teams of the Magnetics Technology Committee. The Japanese Electrotechnical Committee has been deliberating on drafts of International Electrotechnical Commission (IEC) standards to assess conformity to guidelines. Standards have been developed to measure and calculate electromagnetic fields, and methods for assessing the magnetic fields in electric power facilities, electrical equipment, and electrical railways have been developed.

In recent years, revisions to human body protection guideline have been pursued by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Revised guidelines have already been issued for low and intermediate-frequency bands below 100 kHz (in 2010) and high-frequency bands between 100 kHz and 300 GHz (in 2020). In addition, the IEEE electromagnetic field safety standards were also revised into a 2019 version (IEEE Std C95.1-2019) integrating conventional standards for low frequencies (IEEE Std. C95.6-2002) and standards for high frequencies (IEEE Std. C95.1-2005). On the other hand, Japanese radio protection guidelines for the nerve stimulation induced by 10 MHz or less electromagnetic fields were revised in 2015 to be consistent with revised guidelines provided by ICNIRP for 100 kHz or less. Subsequently, starting with 5G in 2018, there have been reports on "appropriate state for high-frequency range radio protection guidelines" assuming the use of radio facilities employing frequency bands exceeding 6 GHz near human bodies. Thus, guidelines are being revised in Japan and overseas to adapt to the current technology; however, previously unimagined revisions for wireless technology are expected in future. In addition, in Europe, legislation on occupational exposure is progressing, and it is believed that assessment methods to investigate occupational exposure will become a critical domestic issue.

3. Investigative matters

This investigation committee will research and investigate trends and issues associated with the following items:

- (1) Research trends in uncertainties over low- and high-frequency band exposure assessment techniques and standards (including electromagnetic environment assessment methods, especially for wireless power transmission equipment and automobiles, for which rapid advancements are being made in electromagnetic field application technologies for EV development and sensing)
- (2) Research for changes in electromagnetic environments and the corresponding electromagnetic field assessment techniques, stemming from the undergrounding of DC power transmission and distribution, deployment of wireless power transmission systems to the general environment, and spread of advanced technologies such as 5G systems to the general environment
- (3) Use of electromagnetic fields in MRI, hyperthermia, and other advanced medical applications, and analytical methods
- (4) Present state of advanced dosimetry techniques for electromagnetic field analysis effective in assessing exposure and performance comparison for electromagnetic field analysis tools
- (5) Guidelines revisions

4. Expected effects

Based on cooperative research conducted by researchers and engineers on low to high frequencies, it could be possible to ascertain changes in electromagnetic environments related to human body protection resulting from

rapidly changing new energy systems and information communication systems and to determine the latest trends in advanced electromagnetic field measurement techniques, numerical electromagnetic field analysis techniques, and ICT technology that can be applied to assess exposure. In addition, such research will enable us to identify the latest domestic and overseas trends related to the assessment and standardization for induced physical quantities in the human body. Thus, the present state of conformity or uncertainty with the present guidelines for assessment methods may be clarified, which is expected to clarify future research challenges.

5. Term of investigation

July 2021 to June 2024

6. Committee members

Position	Name	Affiliation	Member/Non-member category of IEEJ
Chairperson	Yukihisa Suzuki	Tokyo Metropolitan University	Member
Member	Tomomichi Omote	Japan EMF Information Center	Member
"	Yoshihito Kato	Railway Technical Research Institute	Member
"	Yoshitsugu Kamimura	Utsunomiya University	Member
"	Kazuyuki Saito	Chiba University	Non-member
"	Kenji Shiba	Tokyo University of Science	Member
"	Kaoru Someno	Restar Communications Corporation	Non-member
"	Masao Taki	Tokyo Metropolitan University	Member
"	Hiroo Tarao	National Institute of Technology, Kagawa College	Member
"	Shoji Hamada	Kansai University	Member
"	Hiroyuki Hayama	Kansai Transmission and Distribution, Inc.	Non-member
"	Osamu Fujiwara	The University of Electro-Communications	Member
"	Tetsuyuki Michiyama	Nihon University	Member
"	Takashi Yasunaga	Dassault Systèmes S.E.	Non-member
"	Sachiko Yamaguchi	National Institute of Occupational Safety and Health, Japan.	Member
"	Kenichi Yamazaki	Central Research Institute of Electric Power Industry	Member
"	Kanako Wake	National Institute of Information and Communications Technology	Member
"	Takashi Hikage	Hokkaido University	Member
"	Kensuke Sasaki	National Institute of Information and Communications Technology	Member
Secretary	Takeo Shiina	Central Research Institute of Electric Power Industry	Member

7. Activity schedule

Committee meetings: 4 times/year; Secretariat: 2 times/year; Technical Meeting: 1 time/year

8. Reporting format

Reported as a special issue of a paper journal (about five items planned to be posted)

Reason: If content related to this investigation committee is published in a special issue of TEEE, it is

assumed that individuals interested in the knowledge obtained through the activities of the committee will browse the journal, which may lead to subscriptions or individual purchases. In addition, papers may be translated into English depending on content, and if activities and results are presented internationally, the world could become aware of the presence of the IEEJ, further helping to invigorate academic societies.