Electrical Insulation News in Asia

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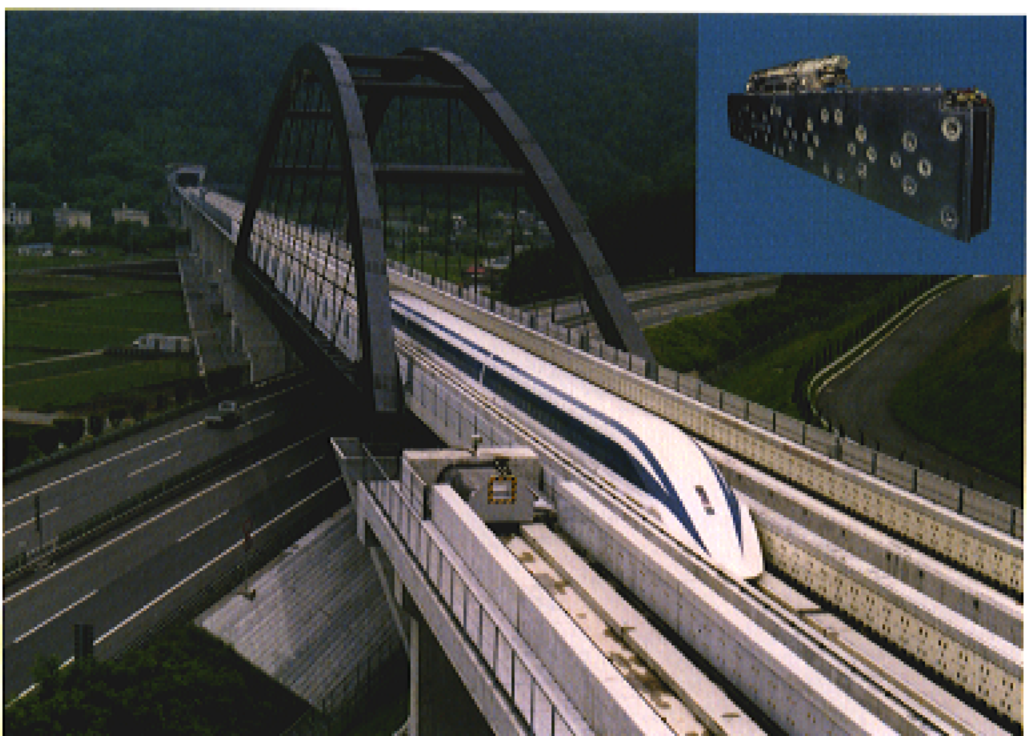

IEEJ

CONTENTS

PREFACE

Prof. K. Matsu-ura

Functional Insulation Diagnostic Technology is an Essential Pre-requisite for the Enriched Electric Power Systems in Asia

Asia, as regional entity, now has the economical and technological potential to pay a dominant role in the global economy of 2000s. The gross domestic products (GDP) in 1990 and the annual growth rate of GDP over 1980s across ASEAN countries were 314.26×10^9US$ and 5.83 %, respectively. These levels of average economic growth in ASEAN countries stand in distinct contrast to the average OECD annual growth rate for the same period around 2.7%. Across all the ASEAN countries, manufacturing contributed well over one-third of GDP and over 40% of exports.

Economic growth represents transformation in the structure and the quality of electric powersystem, and also increase in installed capacity of power equipments. In such situation, reliable evaluation of power equipments with minimal outages and allocated labor resources is a matter of great importance to utilities in many countries in Asia. Thus, research and development in technology for the condition based insulation diagnosis for power apparatus was coming to be very active in 1980s in P. R. China, and Japan and the China-Japan Conference on Electrical Insulation Diagnosis started in 1990. The first conference was held at Xi'an Jiaotong University in April, 1990. It was organized and chaired by Professor Z. Yan of Xi'an Jiaotong University. Since then, the conferences were held every two years; 1992 in Shanghai, 1994 in Osaka and 1996 again in Xi'an. I hope the conference will expand its activity into all over the Asia in future.

In my experience, joint research on electrical insulation diagnosis for power apparatus among utility, manufacturer and university will produce fruitful results which work out in practice. This is because maintenance experiences in utility site engineers, thorough understanding of insulation design and manufacturing process of power equipments, and great skill of detecting small signals of deterioration using computer aided signal processing technique are necessary for us to hatch out functional insulation diagnostic technology.

Another point at which our eyes must be directed is the deregulation in regular inspection of power equipments. It allows utilities to make the interval of overhaul longer. Motivations behind the deregulation are the competitive price of electric energy and the progress in technology for the predictive maintenance. In this connection, it is an urgent necessity for us Asian insulation engineers to develop a hardheaded technology for the life expectancy-oriented in-service insulation diagnosis. This will be an avenue to the enriched electric power systems in Asia.

Dr. Kenji Matsu-ura
Osaka University

EDITORIAL

Dr. S. Yasufuku

Nowadays, the international standardization of electrical material including electrical insulating material is actively in progress, thanks largely to the IEC (International Electrotechnical Commission) in cooperation with related countries. It goes without saying that new electrical materials and testing / measuring techniques are successively developed and practically applied, and existing electrical materials and testing / measuring techniques are frequently improved due to their rapid progress, it must be done in time to standardize internationally them and to revise the existing IEC standards.

Next, domestically, the national standards and organization standards are newly enacted and revised at timely intervals, in concert with the related IEC standards as much as possible.

In IEEJ, how is the above-mentioned standardization going on about the electrical insulating material at large?

(1) The electrical material standing committee (chaired by Prof. T. Hino of Kanagawa Univ.) takes charge of IEC TC10 (liquid and gaseous Dielectrics) and TC15 (electr. Insul. Materi.) domestic committees. Naturally, Japan is positively participating in the IEC TC 10 and TC 15 activities.

(2) The electrical material standing committee is also responsible for making related Japanese Electrotechnical Commission (JEC) standards which are one of the organization standards. Incidentally, the JEC is the oldest organization in Japan which was set up in IEEJ in 1910 for promoting standardization of electricity-related matters and as a Japan's window organization on the whole IEC activities. At present, the JEC activities are to cooperate with the Japanese Industrial Standards Committee (JISC) about the IEC activities, to participate in enacting the Japanese Industrial Standards (JIS), and to promote the standardization for making the JEC standards. It is well-known that the JEC standards are the most authoritative, neutraldomestic ones in Japan's electrical scope. Recently, the JEC published electrical insulation-related standards mentioned as follows :

JEC-6147-1992, "Thermal Evaluation And Classification of Electrical Insulation."

JEC-6149-1995, "Methods of Test For High Voltage, Low Current Arc Resistance of Solid Electrical Insulating Materials Under Dry Conditions."

JEC-6151-1995, "Guide For The Determination of Thermal Endurance Properties of Electrical Insulating Materials."

JEC-6152-1996, "Determination of The Effects of Ionizing Radiation on Electrical Insulating Materials.

It is vital to continue to make the JEC standards for electrical insulation in Japan who's contents agree with those of the corresponding IEC standards as much as possible. From now on, the JEC will make its effort to make new JEC standards about the timely and important electrical insulation-related topics which the technical committee on the DEI in IEEJ have dealt with preferentially.

Now that the EU exercises its overwhelming power in international standard-ization activities through the IEC and ISO, it is hoped that both Japan and Asian countries should insist on what they want in the specifications, hand in hand.

Dr. Sachio Yasufuku (Tokyo Denki University)
(Member of the Electrical Material Standing Committee of JEC in IEEJ)

OUTLINE OF TECHNICAL COMMITTEES ON DEI AND RELATED TC IN IEEJ

Technical Committee on Dielectrics and Electrical Insulation (DEI)

Chairperson: M. Kosaki (Toyohashi University of Technology)
Secretaries: Y. Ohki (Waseda University)
Y. Mitsui (Toshiba Corp.)
Assistant Secretaries: H. Miyata (Fujikura Ltd.)
Y. Tanaka (Musashi Institute of Technology)

This Technical Committee (TC-DEI) was set up in 1979 succeeding the Permanent Committee on Electrical insulating Materials at the reorganization of IEE of Japan. The activities of the Committee are covering mainly solid and composite dielectric and insulating materials and technology.

The primary activity of TC-DEI is the annual Symposium of Electrical Insulating Materials (SEIM). In 1996 the 28th SEIM was held at Musashi Institute of Technology in Tokyo on September 17 and 18. Seventy-two papers were presented including the invited paper of Dr. L.A.Dissado of Leicester University, England. The 29th SEIM will be held in Osaka in the end of September this year. The 30th SEIM will be jointly held with IEEE DEIS, Chinese Electrotechnical Society and Korean IEE in the style of International SEIM (ISEIM-98) in Toyohashi in the end of September, 1998.

TC-DEI organizes the Seminar for Young Researchers of Dielectric and Electrical Insulation every two years. It will be held in Hayama, Kanagawa on October 8-10.

TC-DEI currently runs nine Investigating Committees (IC) which organize Technical Meetings (145 papers in 1996) and one Cooperative Research Committee (CRC) which edits and publishes this EINA.

Table 1 Investigation committees in TC-DEI

Research Subject	Chairperson
Interfacial Phenomena in Composite Electrical Insulation (3 years from Jan.1995)	T. Tanaka (CRIEPI)
High Temperature Insulation (3 years from Jan. 1996)	T. Okamoto (CRIEPI)
Deterioration of Insulation Materials and Standardization of Diagnosis for Power Apparatus (3 years from Jan. 1996)	T. Hayami (Musashi Institute of Technology)
Root Principles of Electro-Optic Conversion Functions and their New Application Fields (3 years from Apr. 1996)	K. Hidaka (Tokyo University)
Evaluation Methods of High Reliability Insulation Technology for Electronic Equipment (3 years from Apr. 1996)	T. Tsukui (Tokai University)
Interfacial Electronic Phenomena and Intellectual Properties of Organic Thin Films (3 years from Jan. 1997)	M. Iwamoto (Tokyo Institute of Technology)
Inverter Surge Insulation (2 years from Apr. 1997)	K. Kimura (Mitsubishi Electric Corporation)
Standardization of Space Charge Measurement in Dielectric / Insulating Materials (3 years from Apr. 1997)	T. Takada (Musashi Institute of Technology)
Structure and Functions of Molecular Ultrathin Films, Organic Thin Films and Interfaces (3 years from July 1997)	F. Kaneko (Niigata University)
Electrical Insulation News in Asia (EINA) (2 years from Apr. 1996)	H. Yamashita (Keio University)

Activities of the Technical Committee on Electrical Discharge

Chairperson :	M. Hara (Kyushu University)
Secretaries :	K. Hidaka (University of Tokyo)
	M. Yumoto (Musashi Institute of Technology)
Assistant Secretaries :	T. Nakano (National Defense Academy)
	M. Hanai (Toshiba Corporation)

The Technical Committee on Electrical Discharge (TC-ED) has been charged with offering the opportunities for the members of IEE of Japan in the research field of electrical discharge to present their achievements, and studying and reporting on current status and future challenges in electrical discharge engineering. It was established formally on 1980, but its root goes back to the start of Technical Committee on Electrical Physics on 1954. In order to meet the objective, a few subcommittees of the TC-ED are organized every year to survey the up-to-date subject and each of them continues for three years normally.

In the past, the following subcommittees were active and published the Technical Research Reports on a relevant subject: Discharge Simulation Methods; Surface Discharges in Diverged Fields; V-t Characteristics in SF6; Conduction and Breakdown in Dielectric Liquids; Plasma Processing; Fundamental Processes in Non-LTE Plasma; Simulation in Non-LTE Plasma; Field Measurements in Electrical Discharges; Breakdown Mechanism and Characteristics of Gas Mixtures; Modeling of Long Sparks; Interaction between Sparks and Laser; Space Charge Effects on Electrical Breakdown in Insulating Liquids; Effects of Interface and Foreign Matters on Electrical Breakdown in Insulating Liquids; High Stress Phenomena in Cryogenic Liquids; Plasma Reactors; Plasma Display; Database for Gas Discharges; Beam and Swarm Data for Gas Discharges and Plasma; Plasma Chemistry; Electrical Breakdown in Vacuum and so on. Total number of the past subcommittees is 33 and the published technical reports reach 27 at the end of 1996.

Now ten subcommittees are working for a survey of the listed subjects. Each subcommittee consists of 20-30 members who are the specialists in the research subject of the committee or are interested in it.

The TC-ED is also supporting the domestic meetings on electrical discharges about ten times a year where about 250 full papers are reported by young scientists and students from universities and institutes and engineers from industries every year.

The international and domestic conferences and annual seminar for young researchers are also promoted by the TC-ED in cooperation with the Technical Committee on Dielectrics and Electrical Insulation, IEE of Japan, The Institute of Electrostatics of Japan and The Japan Research Group on Electrical Discharge which consists of about 400 members whose backgrounds covers a wide area of electrical properties of solids, liquids and gases.

Table 1 Investigation committees in TC-ED

Research Subject	Chairperson / Secretaries / Assistant Secretaries
Interactive Relations between Electrical Discharge and Laser	T. Takuma / T.Shindo, K.Hidaka / K. Miki
The Development of Data Base on Electrical Discharge in Gas	K. Horii / T.Takano, M.Chiba
Electron Collision Cross Section Data Base for Low Temperature Plasma	Y. Sakai / H. Itoh, S.Takagi / Y. Saitoh
Conduction and Breakdown Characteristics in Dielectric Liquids and Their Applications to Electric Power Apparatus	H. Okubo / K. Kojima, N. Hayakawa / S. Yamada
Plasma Properties for the Technique of Promising Prospective Plasma-Processing	M. Sugawara / M. Ouchi, S. Ono / A. Matsuoka
Charged Particle Generation and Emission in Vacuum and Related Technologies Controlling Electrical Discharges	S. Kobayashi / Y. Saito, M. Yumoto / Y. Suetsugu
Discharge Plasma Applications for Environmental Protection	T. Oda / H. Ito, K. Soma

	/ K. Simizu
Modeling of Nonequilibrium Plasma and Related Plasma Etchings	T. Makabe / H. Kouno, S. Samukawa
Pulsed Power Discharges and Applications	H. Akiyama / T. Sakukawa, Y. Nakazawa / J. Katsuki
Plasma Display Discharge and Emission	S. Mikoshiba / S.Hashiguchi, T.Yoshioka

Technical Committee on High Voltage Engineering

Chairperson	M. Ishii (Tokyo University)
Secretaries :	T. Yabushita (Mitsubishi Electric Co. Ltd.)
	A. Inui (Toshiba Corporation)
Assistant Secretary :	H. Motoyama (Central Research Institute of Electric Power Industry)

The 100th meeting of the High Voltage Engineering Technical Committee will be held in the next year, which means that this committee is about 24 years old. This committee supervises investigation committees in the field of high voltage engineering except on high voltage apparatuses or on fundamentals. There are five running investigation committees in August 1997. Also, the three investigation committees will start functioning soon. Their names and the chairpersons are shown in Table 1.

It is seen from the above subjects of investigation, that the scope of this technical committee resembles, but is broader than, the CIGRE Study Committee 33 (Overvoltages and Insulation Coordination). Moreover, an investigation committee on insulation coordination is planned to start in the next fiscal year.

The technical committee plans to organize eight technical meetings in the fiscal year of 1997, five of which will be jointly organized with other technical committees of IEEJ related to high voltage engineering, such as Electrical Discharge Technical Committee or Switching and Protection Technical Committee. In January 1977, a symposium on electric and magnetic phenomena associated with earthquakes organized by the technical committee was successfully held in Osaka.

The technical committee usually meets four times a year, and one of the meetings is held associated with a technical visit by the committee members to facilities related to high voltage engineering. This year the committee members visited the testing field of a UHV prototype transformer, about 100km north of Tokyo. The members of the committee other than the chairpersons of the investigation committees are from universities (4), research institutes (2), electric power utilities (4), and manufacturers (9).

Table 1 Investigation Committees in TC-HVE

Research Subject	Chairperson
(running)	
Application of Large Current Energy Investigation Committee	T. Inaba
Insulation and Surge Characteristics of Equipments of Distribution Line	S. Yokoyama
Modeling for Advanced Evaluation of Lightning Surge Analysis	A. Ametani
Improvement of Monitoring Devices against Insulator Pollution	S. Nishimura
Measurement of High Voltage AC and DC	H. Hirayama
(to be established soon)	
Testing Technique of Impulse Voltage and Current Measuring Systems	T. Harada
Electric and Magnetic Phenomena Associated with Earthquakes	K. Horii
Lightning Location Systems	M. Ishii

ACTIVITIES OF THE TECHNICAL COMMITTEE ON DEI IN IEEJ

Digest Reports of Investigation Committees in DEI

Digest Reports on activities of investigation committees in the technical committee on DEI are reproduced here from the Proceedings of the 29 th Symposium on Electrical Insulating Materials (Sept. 1997, Osaka Japan).

Fundamental Process of Treeing Degradation

K. Kudo (Meiji University)
N. Shimizu (Nagoya University)
H. Muto (The Furukawa Electric Co. Ltd.)

This committee was established in April, 1994 and terminated in March, 1997. This committee consisted of 21 members. The items of survey were as follows:

(1) Fundamental process of initiation and propagation of electrical tree under ac, dc or impulse voltage.
(2) Fundamental process of initiation and propagation of water tree.
(3) Propagation process of electrical tree originating from water tree.

The three year activity of this committee will be published in Technical Report of IEEJ next year.

Interfacial Phenomena in Composite Electrical Insulation

T. Tanaka (Central Research institute of Electric Power Industry)
M. Nagao (Toyohashi University of Technology)
Y. Yamashita (Furukawa Electric Co. Ltd.)
F. Honma (Central Research institute of Electric Power Industry)

The purpose of this committee is to survey and discuss the influence of interfaces on the electrical insulating properties of composite electrical insulating systems. The committee started its three-year term activity in January 1995 by 28 members. We have held 13 committee meetings and 6 secretary meetings up to July 1997. The main subjects of the investigation and survey in the meetings are as follows:

(1) Electrical insulation properties of external and internal interfaces in composite insulation systems.
(2) Evaluation method of electrical insulation performance of interface.
(3) International Round Robin Tests of electrical insulation at external and internal interfaces in composite insulation system and the analysis of the results in collaboration with CIGRE WG15-10 (Interfaces).
(4) Study visit to the research institutes and industries in Japan related to the composite electrical insulation.

More than 130 papers have been presented and discussed in the committee. The three year activity of this committee will result in the Technical Report of IEEJ in early 1998.

High Temperature Insulation

T. Okamoto (Central Research Institute of the Electric Power Industry)
M. Ishida (University of Tsukuba)
H. Mitsui (Toshiba Corporation)
M. Okashita (Showa Electric Cable & Wire Co. Ltd.)

The committee was set in January 1996 with 30 members in order to survey technical information concerning high temperature insulations and their applications.

(l) Purpose of establishment

Many power equipments and cables have been compacted and applied to severer environmental use and therefore the design stress for the insulating materials increased not only in electrical stress but also in thermal stress. High temperature insulating (HTI) materials could be one of the solutions for the requirements for insulation in severer use. This committee aims to survey the modern high temperature insulating materials and their applications.

(2) Investigation Items

The committee member determined the investigation items as follows:

1) Classes and kinds of high temperature insulating materials
2) Electrical properties of HTI
3) Physical and chemical properties of HTI
4) Applications of HTI
5) Test methods of HTI performance
6) Future trends of HTI

(3) Activity

Since the establishment of the committee, three regular meetings and a secretary meeting have been held. About 200 papers were presented and discussed in the committee. In Jan. 1997, a research meeting on high temperature insulation was held in Toyohashi University of Technology sponsored by the committee. The activity are in the first stage where selected papers will be reviewed and discussed. Three years activity of this committee will be published in Technical Report of IEEJ.

Deterioration of Insulating Materials and Standardization of Diagnosis for power Apparatus

T. Hayami (Musashi Institute of Technology)
T. Ito (Musashi Institute of Technology)
K. Umemoto (Toshiba Corp.)
K. Uchida (Chubu Electric Co. Inc.)

The committee started its three-year term activity in January 1996.

The following activity have been achieved by the committee:

(1) Investigation on relationship between the fundamental degradation phenomena such as partial discharge, electrical and water tree, and various electrical signals due to the degradation.

(2) Investigation on present criteria for determination of the existence of degradation for power apparatus. The 3-33kV distribution power equipment is subject to investigation of the committee including rotating machine, cable, transformer, capacitor and switch gear.

Root Principles of Electro-Optic Conversion Functions and their New Application Fields

K. Hidaka (Tokyo University)
T. Maeno (Communications Research Laboratory)
N. Inoue (Mitsubishi Cable Industry)

This committee started in April, 1996 after two year discussion among DEI technical committee members and will be continued until March, 1999. The purpose of it is to review the fundamental functions and the physical properties of electro-optic conversion, to understand the essentials of the electro-optic conversion functions, and to propose new engineering applications. Optical measurement techniques using the electro-optic conversion such as electro-optic effect have been developed since 1970's, and some optical devices have been incorporated into electric power systems and also have been implemented to obtain a better physical understanding of dielectric and electrical-discharge phenomena. Typical examples characterizing the electro-optic conversion functions are: Pockels effect, Kerr effect, Faraday effect, electro-gyration effect, magnetic Kerr effect, opt-magnetic effect, optical anisotropy of liquid and so on. As each effect has independently applied to some engineering fields, many useful effects will be systematically reviewed and discussed in this committee.

Evaluation Methods of High Reliability Insulation Technology for Electronic Equipment

T. Tsukui (Tokai University),
Y. Yamano (Chiba University)
K. Shutoh (Science University of Tokyo),
M. Nonogaki (Mitsubishi Electric Co. Ltd.)

Electric equipment is becoming small in size, light in wieght, and high in performance. The printed wiring boards for the equipment are designed in fine and high density, which results in small distance and high electric field strength between the foil conductors on the board. The insulating failures may occur on the board under such conditions. Therefor, an insulating reliability comes up to an important problem for the design of electronic equipment and systems.

From these viewpoints, the investigation committee started in April 1996. The main subjects of the committee are as follows:

(1) Survey on test methods for insulating failures due to the ionic migration.
(2) Comparison of factors affecting insulating failures with results from life tests.
(3) Assessment of the standard test method of insulating reliability.
(4) Research for cause of the insulation failure in electronic equipment and systems.

We have held 9 committee meetings and 2 organizer meetings since the start of this committee. Now, we are carrying out the round robin tests of the ionic migration to investigate the subjects (2) and (3) listed above.

Interfacial Electronic and Intellectual Properties of Organic Thin Films

M. Iwamoto (Tokyo Institute o f Technology)
H. Usui (Tokyo University of Agriculture and Technology)
M. Onoda (Himeji Institute of Technology)

This committee was established in January 1997 to investigate the interfacial electronic phenomena and intellectual properties of organic thin films. Since then, the study meeting was held 3 times until July of this year. The main investigation subjects of this committee are as follows:

1) Trends and topics on the nano-interfacial phenomena in highly-ordered organic thin films and super-structured organic films.
2) Electrical and optical properties of organic films arising from the nano-interfacial property of organic films.
3) Topics and trends on the intellectual property of organic films.
4) Others.

Inverter Surge Insulation

K. Kimura (Mitsubishi Electric Corporation)
K. Mori (Toshiba Corporation)
K. Haga (Fuji Electric Corporated Research & Development, Ltd.)
K. Ishii (National Defence Academy)